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The Electrical Experimenter

233 Fulton Street, New York.

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IN profound sorrow, we announce the death of our

Mr. Milton Hymes

Secretary, Business and Advertising Manager of the Experimenter Publishing Co., and Secretary of the Electro Importing Co.

Mr. Hymes had just completed an exceedingly successful advertising trip thru the Middle West, visiting Milwaukee, Chicago, Detroit, Toledo, Dayton, Cleveland and Pittsburg. He left the latter city on the evening of February 26th, and was due in New York the following morning, when he met his tragic death in the fearful wreck of the Pennsylvania Railroad near Altoona, Pa., which caused the death of twenty other passengers.

A great deal of the success of "The Electrical Experimenter" is directly due to Mr. Hymes, whose indefatigable zeal and enthusiasm, his unflinching labors and his keen insight in business affairs helped to make the publication one of the greatest of its kind in the country.

In Mr. Hymes "The Electrical Experimenter" has lost one of its most tireless as well as capable workers and to us his untimely death certainly is irreparable.

An upright, fearless man, a devoted son, a faithful husband, a stanch friend and an exceptional business associate, his passing is mourned by hundreds. Though only 28 years old, his charming personality made him scores of friends in electrical and advertising circles and his loss is keenly felt by all.

Milton Hymes will continue to live forever in our hearts.

THE PUBLISHERS.

THE ELECTRICAL EXPERIMENTER is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $1.50 a year in U. S. and possessions. Canada and foreign countries, $2.00 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 15 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of THE EXPERIMENTER PUBLISHING CO., INC. If you change your address notify us promptly, in order that copies are not miscarried or lost. **A green wrapper indicates expiration. No copies sent after expiration.**

All communications and contributions to this journal should be addrest to: Editor, THE ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York Unaccepted contributions cannot be returned unless full return postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

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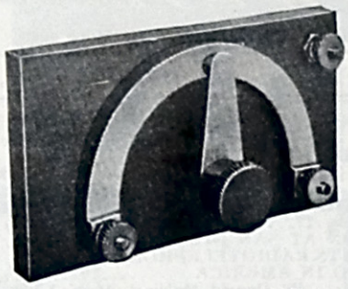

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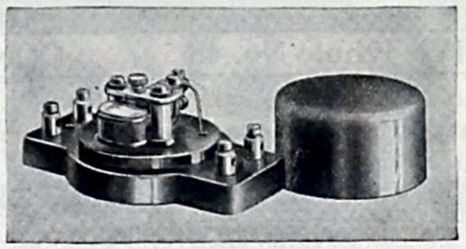

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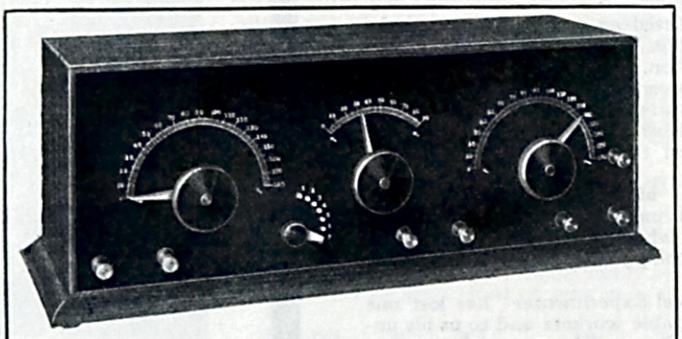

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THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

Vol. IV. Whole No. 48 APRIL, 1917 Number 12

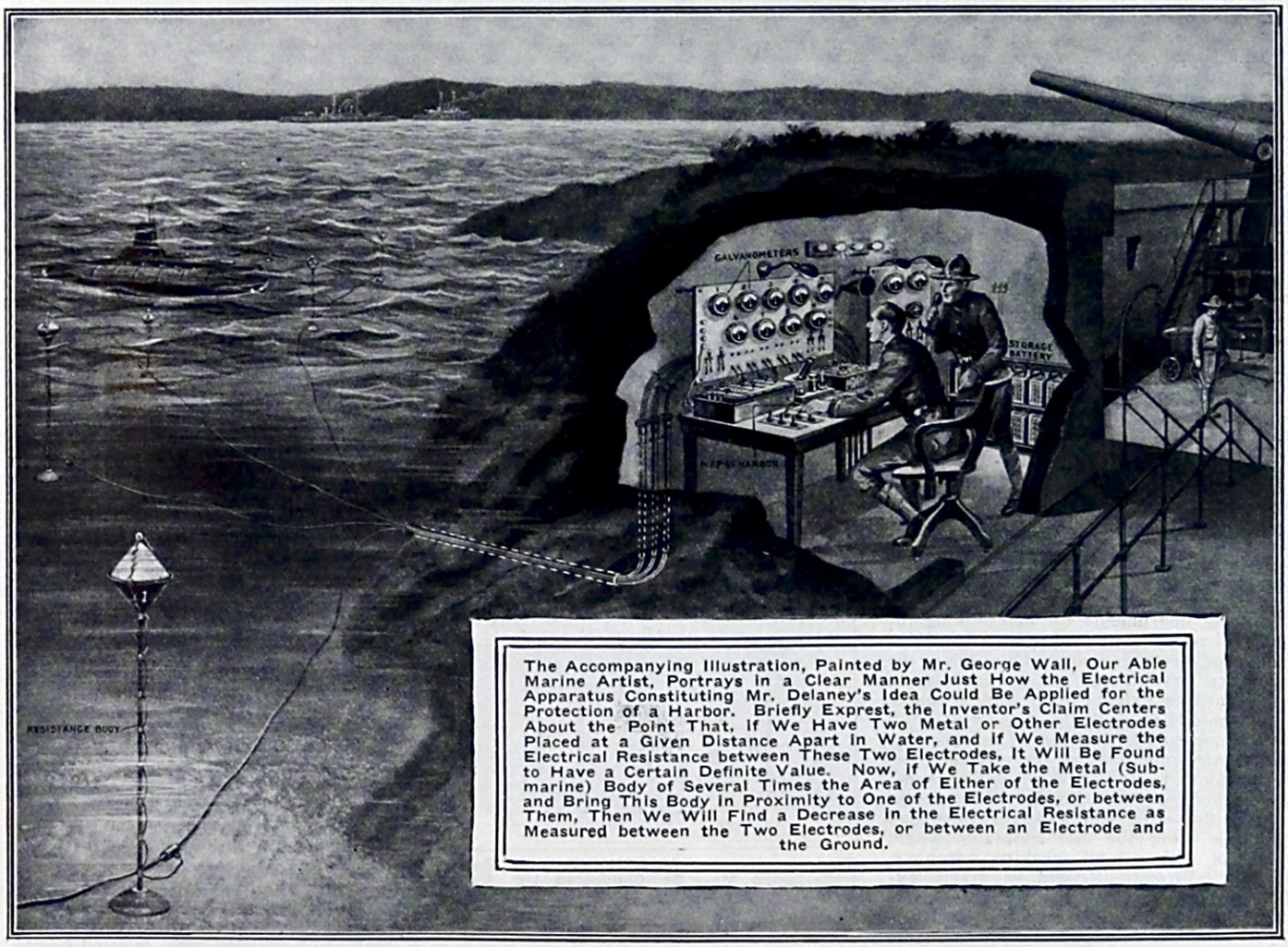
Locating Hidden Submarines by Electricity

By H. WINFIELD SECOR

AN extremely interesting and apparently heretofore unthought of electrical scheme of extreme simplicity for the detection and location of submerged metallic bodies, such as submarines or sunken wrecks, has been patented by a well-known American inventor, Mr. Patrick B. Delaney. The accompanying illustration, painted by Mr. George Wall, our able marine artist, portrays in a clear manner just how the electrical apparatus constituting Mr. Delaney's idea could be applied for the protection of a harbor. Briefly exprest, the inventor's claim centers about the point that, if we have two metal or other electrodes placed at a given distance apart in water, and if we measure the electrical resistance between these two electrodes, it will be found to have a certain definite value. If we take a metal (submarine) body of several times the area of either of the electrodes, and bring this body in proximity to one of the electrodes, or between them, then we will find a *decrease* in the electrical resistance as measured between the two electrodes, or between an electrode and the ground.

The illustration here reproduced shows the necessary apparatus as it might be installed in a suitably protected bomb-proof room in a fort or other suitable location, and as the officer in charge of this work would have before him a map of the area thus equipt with Delaney *electrode-buoys*, it would be a simple matter for him to quickly locate the position of an enemy submarine or other metallic body such as a wreck, et cetera.

It should be borne in mind also, that practically all American harbors are plentifully sprinkled with special *electric mines*, the position of each mine being accurately known and plotted on a map in possession of an officer on shore. Before him there is an electrical switch and signal board, with a contact on it for each mine by number. As soon as a ship approaches one of these mines the officer has but to press an electric

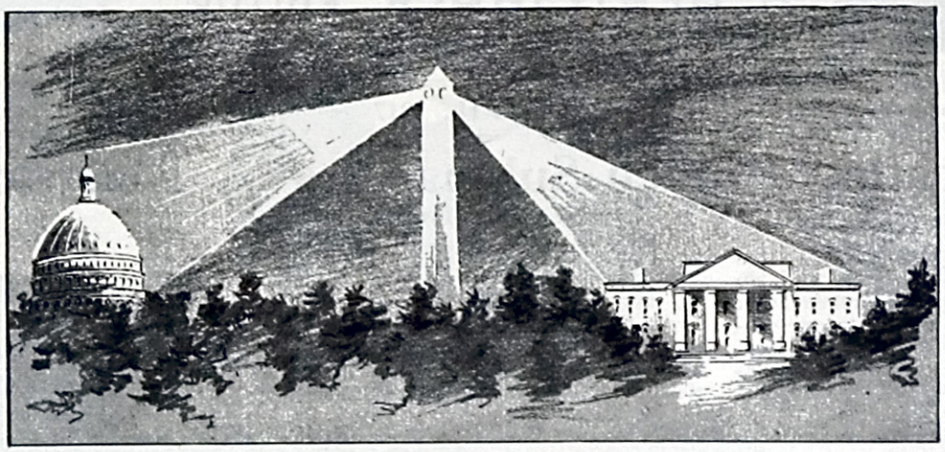


The Accompanying Illustration, Painted by Mr. George Wall, Our Able Marine Artist, Portrays In a Clear Manner Just How the Electrical Apparatus Constituting Mr. Delaney's Idea Could Be Applied for the Protection of a Harbor. Briefly Exprest, the Inventor's Claim Centers About the Point That, If We Have Two Metal or Other Electrodes Placed at a Given Distance Apart In Water, and If We Measure the Electrical Resistance between These Two Electrodes, It Will Be Found to Have a Certain Definite Value. Now, If We Take the Metal (Submarine) Body of Several Times the Area of Either of the Electrodes, and Bring This Body In Proximity to One of the Electrodes, or between Them, Then We Will Find a Decrease In the Electrical Resistance as Measured between the Two Electrodes, or between an Electrode and the Ground.

SCHEME TO LIGHT WASHINGTON MONUMENT, CAPITOL AND WHITE HOUSE WITH ONE SEARCHLIGHT.

A NOVEL patent has recently been issued to Mr. Frank H. Ellison whereby it is proposed to erect suitable large size mirrors at the top of the Washington Monument in Washington, D.C., so that a powerful searchlight beam projected from the Hotel Raleigh could, by means of the doubly reflected beams from the mirrors, be caused to illuminate the dome of the Capitol as well as the White House simultaneously. The idea involved is apparently to increase the illuminating efficiency.

The accompanying illustration shows the idea in a clear manner and the inventor certainly deserves credit, as it is the first time to our knowledge that such a double reflecting scheme has been proposed on such a large scale. The patentee has covered the details for the construction of the mirror supporting frames and also the angle they shall take with respect to the buildings to be lighted and also with respect to the walls of the Washington Monument. This scheme would seem applicable to many other illuminating problems where such a high structure as the Washington Monument is available on which to mount suitable mirrors or reflectors. The searchlight beam proper is not shown in the illustration here reproduced, but would be projected toward the Monument approximately from the position occupied by the reader of this article.



A Novel Scheme Worked Out by an Inventor of Washington, D.C., whereby a Single Searchlight and Two Large Mirrors Will Serve to Illuminate the White House and Capitol.

U-BOAT USED RADIO DECOY.

A recent dispatch from Amsterdam states that German submarines are now sending out S O S wireless signals to lure British vessels to destruction.

The *Telegraaf* learns from an officer of a large steamer of an important Dutch line that while on a voyage from the Dutch East Indies he received while in the Bay of Biscay an S O S message. The ship immediately rushed to the place indicated and found a German submarine, which was not in distress. The captain of the submarine exprest regret that it was a Dutch and not a British ship that had heard the call.

JAPAN'S NEW RADIO WITH UNITED STATES.

The efficiency of Japan's new wireless station, which is now in regular communication with the United States by way of Hawaii, was strikingly shown by its recent picking up of messages sent from Northern Germany and from some other continental wireless station. The Japanese station, which is situated at Funabashi, ten miles east of Tokio, was receiving a message from Hawaii when it picked up several cipher messages addressed to E. G. C., which stands for Madrid, which were being sent by some powerful station some 6,000 miles away.

button and the ship will be blown to pieces. These mines are so powerful that even tho a vessel might be some distance from them, they will be thoroly shattered and put out of commission. It is also possible in the latest type of electric mines to so control them from a fort on shore that they may be exploded automatically, so that ship will detonate the mine by simply striking against, but if a neutral vessel had to pass thru this mine field, then it is possible to open the proper circuits to the mines, so that it will not be detonated by a ship coming in contact with it.

The apparatus required for the application of Mr. Delaney's most ingenious and extremely simple yet important invention, are shown in the accompanying illustration and comprises principally a source of electrical energy of low potential, such as a storage battery and a suitable set of measuring instruments for determining the electrical resistance between any two of the submarine electrode-buoys. One side of the resistance test-circuit, which includes a very sensitive galvanometer and a source of current, is grounded and the resistance may be measured from the water to a submerged electrode-buoy or the resistance between any two or more buoys may be measured. A Wheatstone bridge is shown as part of the equipment and, of course, an operating room for this apparatus would be equipt with a loud speaking telephone, so that information could be freely exchanged between this room and other parts of the fortification. It would be very feasible to combine this apparatus in the same room with the electrical control switchboard for detonating the submerged mines as previously mentioned.

The inventor claims that with a suitable arrangement of galvanometers and a proper arrangement of electrode-buoys anchored at different depths, it is readily possible to quickly and accurately establish the approximate location of submarines or other metallic bodies brought into proximity with one of the buoys, and that it is also possible by such a scheme to determine the direction in which the object is moving and its course. The application of this arrangement has here been shown as applied to a harbor with a detecting station on shore, but it is obvious that the indicating instruments may be located on shipboard when desirable.

It is indeed remarkable that such a simple method of detecting submerged metallic bodies should not have been promulgated or proposed by electricians before, and great credit is due Mr. Delaney for bringing out this practical and efficient electrical submarine detection scheme at this time.

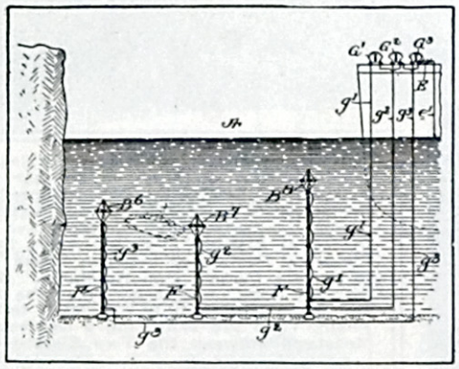


Diagram Showing How the Delaney Electrode-buoys May Be Connected Up, Each to a Distinct and Independent Galvanometer.

WHAT THE U.S. NAVY OFFERS TO YOUNG MEN.

Uncle Sam's Navy offers a wide variety of industrial courses to ambitious young men. If the recruit has had some training or experience in electricity, he may enter either the general or the radio classes of the electrical schools, one at the Brooklyn and the other at the Mare Island Navy Yard. The great advantages of these courses are discust in the annual report of the Secretary of the Navy. Here the course of instruction comprises machine-shop work, reciprocating steam engines, steam-turbine engines, internal-combustion engines, magnetism and electricity, dynamos, motor generators, alternating currents, batteries, and the like. In the radio group there is thoro practise in the radio mechanism for receiving and sending. In the Artificer School at the Norfolk Navy Yard men are taught to be shipwrights, ship fitters, blacksmiths, painters, and plumbers. Both at Newport, R.I., and San Francisco are yeomanry schools, where the men are perfected for the clerical work of the Navy to become expert stenographers, typewriters, bookkeepers, etc.

An attractive line in the Navy is the Hospital Corps, with schools at Newport, R.I., and San Francisco. Not a few men have gone out of these schools after their Navy service to make good doctors in civil life, after the thoro training received in anatomy and physiology, nursing, first aid, and emergency surgery, hygiene and sanitation, pharmacy, materia medica, toxicology, chemistry, and the like. Music is essential to vary the secluded life afloat, and boys with musical talent are instructed in the schools at Norfolk and San Francisco. The machinist school at Charleston is open to men who show themselves apt in mechanical work. The coppersmith school is located also at Charleston. The two commissary schools are at San Francisco and Newport. At Pensacola every three months a class of 16 enlisted men, selected by the commander in chief of the Atlantic Fleet, is trained for an 18 months' course in aeronautics. The course is divided into two classes—mechanics and flying. The men are afterwards transferred to general service and are entitled to additional pay of 50 per cent while detailed to the duty of actual flying. The seaman gunners' school is located at Newport where a special study of the torpedo is made.

New Automatic Electric Buoy Never Fails

NIGHT covers the ocean. A terrific gale sweeps the waters and thru the inky blackness a ship is struggling slowly to find its way. The captain, braving the storm, is on the bridge. He knows that the vessel and all the lives entrusted to him are in greatest danger. Not only on account of the gale, but also because the ship is navigating in highly dangerous, rocky waters. At any moment the vessel may be thrown helpless against a deserted, uninhabited shore.

No light buoys show her the way. It was found impossible to place gas light buoys near these rocks. The gas mantles would not withstand the shocks of the heavy waves which rush with terrible force against the rocky shores. And who shall keep the gas light buoys in operation? Who shall replace here on this deserted coast the fuel and broken burners? So the known danger remained to navigation for many years.

But look! What is this? A red light suddenly flashes over the rolling and thundering waters. It disappears for a moment and then it flashes up again, and again. And over there another one in green. Red and green. Again and again. The passengers stare with surprise at the mysterious, silent lights. They flash and flash. But the officers on the bridge exchange looks of relief and satisfaction.

"Full Steam Ahead!" goes the captain's command into the engine room and the slowly wavering giant starts again to tremble with her powerful effort to plow thru the rough sea. "Automatic Electric Light Buoys" is the succinct answer the captain gives to inquiring passengers. But the ship is saved and the passengers free from danger while the silent, flashing lights slowly disappear in the far distance behind.

* * * *

The *Automatic Electric Light Buoy* is one of the latest and most ingenious inventions of Mr. H. Hartman, a well-known civil engineer of New York, whose electric submarine camera and speaking clock have been described in the December and January numbers of THE ELECTRICAL EXPERIMENTER.

His new electric light buoy produces its own electric current for illumination thru the motion of the waves. It does this in the most simple and ingenious way, avoiding every complicated mechanism which might easily get out of order. It has no storage battery, no automatic cut-out, no relay switch and no *filament lamp* which would break thru the rocking of the buoy in heavy seas.

This electric light buoy has simply a vertical shaft, journaled at both ends in ball bearings, and a bracket which carries a heavy weight consisting of an iron ball, which will always swing by gravity according to any inclination of the buoy when the same is rocked by the waves, turning thereby the vertical shaft more or less. The turning motion of this shaft is increased and transmitted by means of gears to a special magneto at a ratio of say 40 to 1, so that the magneto would make 40 revolutions for each full revolution of the vertical shaft or 10 revolutions for a quarter turn of the same in either direction.

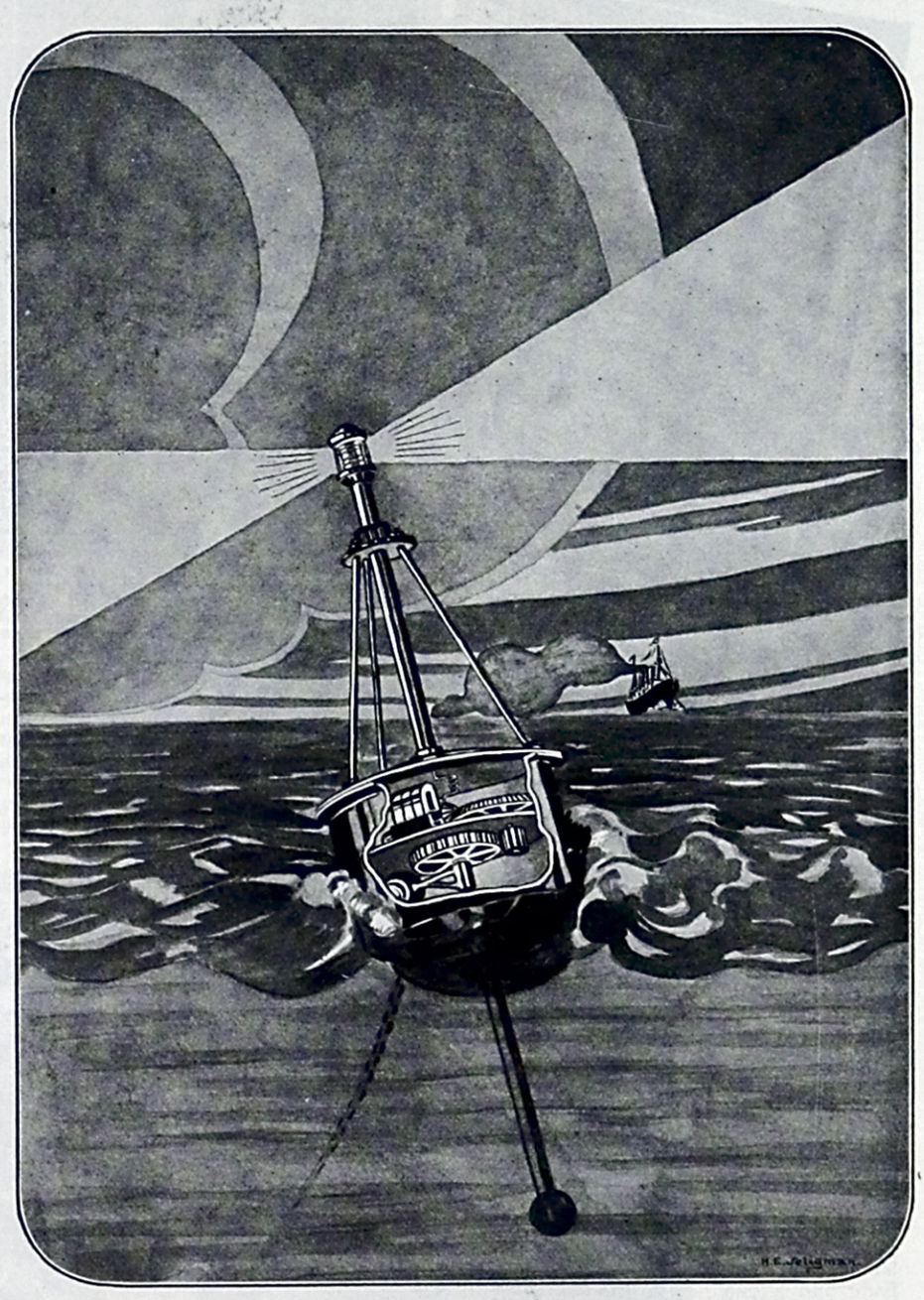
The alternating current of low voltage thus produced by the magneto passes thru the primary winding of an induction coil, which transforms the same into a current of several thousand volts which would give for instance a spark from 1" to 2" or more. One pole of the secondary winding of this induction coil is grounded to the steel body of the buoy, while the second pole is connected by means of a heavily rubber-insulated wire thru the hollow tube of the superstructure of the buoy, with a special lamp which is constructed on the principle of the well-known *Geissler tubes*, becoming highly luminous as soon as a current of high potential passes thru them.

The particular construction of this lamp is kept secret to a certain extent but this much is known: that it consists of a long tube of about ¼" dia., made of glass which contains certain metallic salts and which is wound into a spiral of 1" dia., by approximately 6" length. Thus the luminous element is highly concentrated and to increase the light a second glass tube, sealed at both ends and covered inside with reflecting, non-conductive material, is arranged within said spiral, acting as a reflector in all directions. This spiral lamp hangs vertically with both ends on elastic springs, which are at the same time acting as conductors and shock-absorbers, within an outer larger lamp casing, consisting mainly of the generally known and used prismatic glass cylinder, sealed water-tight at both ends by bronze bushings, as used on ships, boats, gas-light buoys, etc.

This electric lamp gives from 5 to 15 C.P., according to size and current, and tests have proven that it can be seen at night for several miles. The lamp can be made to give white, red or green light and is about 5 to 7 feet above the water-line. At the bottom of the buoy a hollow, tubular shaft extends into the water, which keeps the buoy in a vertical position when there is no motion of the water.

Referring to the illustration, we show one of these automatic electric light buoys

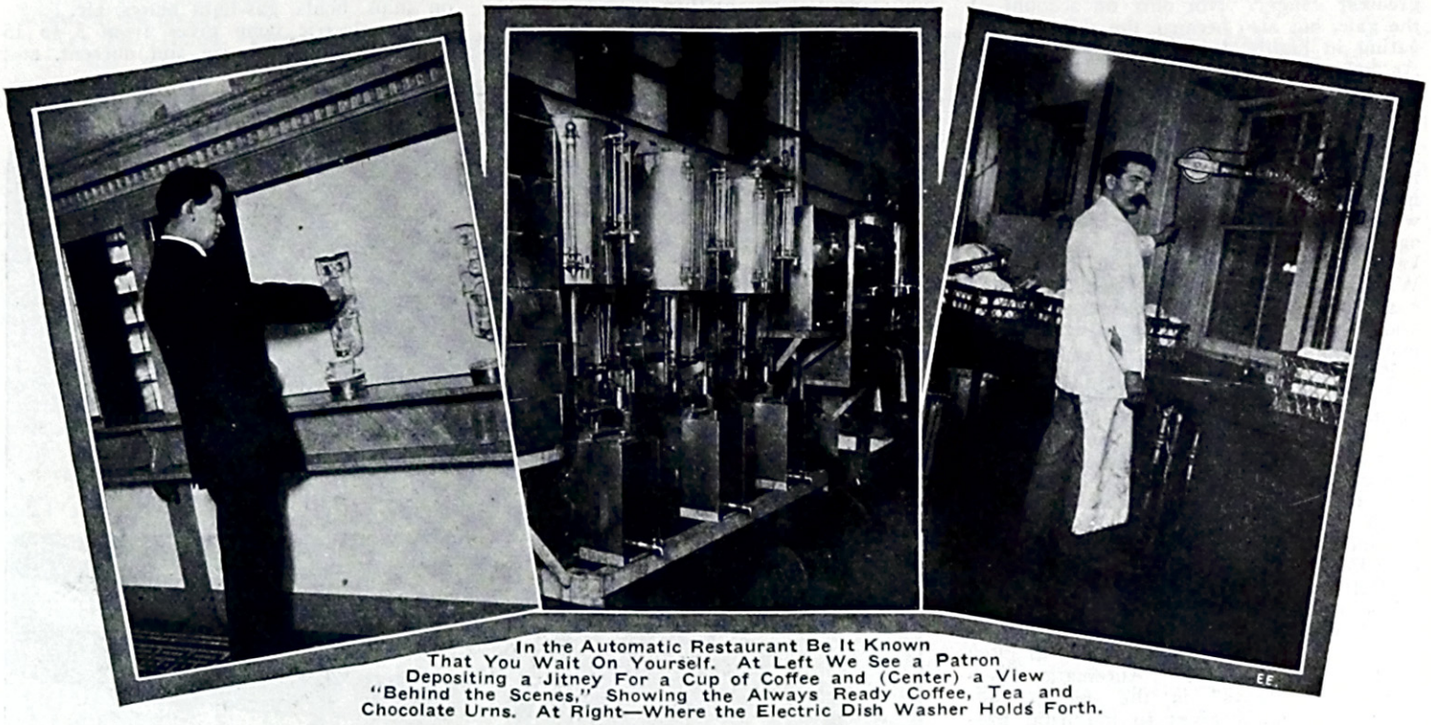
(*Continued on page 939*)



Remarkable New Electric Buoy which, when Rocked by the Waves, Develops Its Own Electrical Energy to Light a Special Vacuum Tube Lamp, Having No Filament. The Lamp Will Last as Long as the Dynamo and Its Inventor Claims that This Buoy Will Care for Itself for Months at a Stretch.

The Automatic Restaurant

ELECTRICITY finds many diversified applications in modern hotel and restaurant service but the greatest of all electrical dreams has come into actual existence in the Automat Restaurants. In the Automat, let it be known, you must wait on yourself. On the other hand you are not under the constant glare of a hard-shell garçon who is forever looking for the inevitable tip. Several of the larger American cities, including New York and Philadelphia, as well as a number of European cities, now have these automatic restaurants.



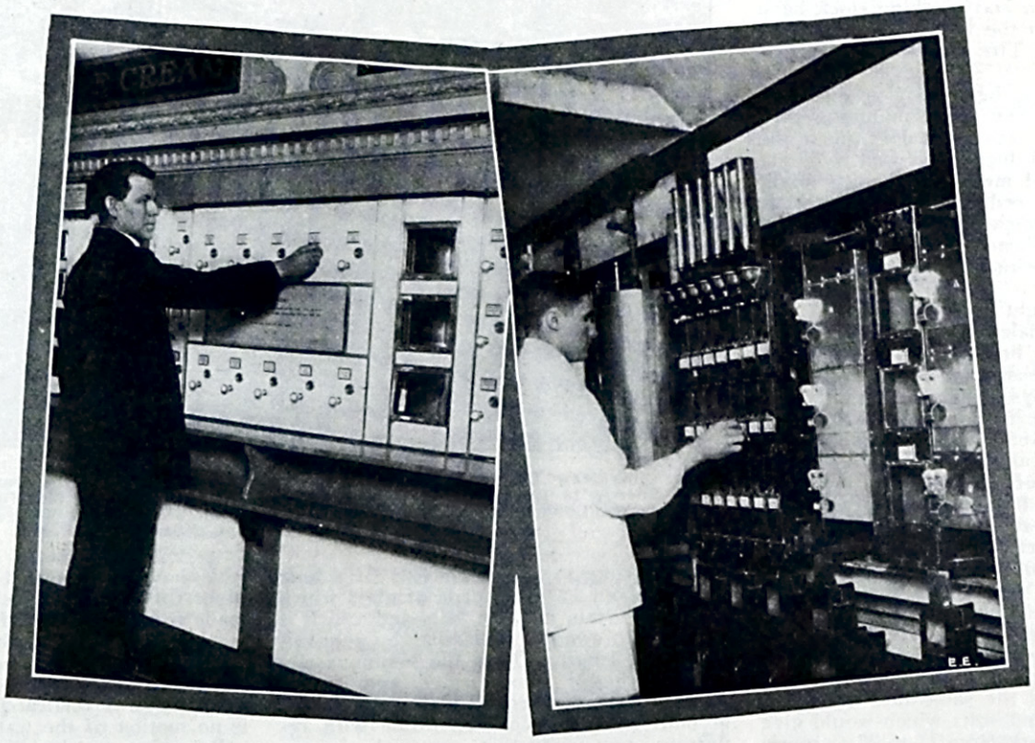
In the Automatic Restaurant Be It Known That You Wait On Yourself. At Left We See a Patron Depositing a Jitney For a Cup of Coffee and (Center) a View "Behind the Scenes," Showing the Always Ready Coffee, Tea and Chocolate Urns. At Right—Where the Electric Dish Washer Holds Forth.

If you have never patronized one of these waiter-*less* food emporiums de luxe, you would most probably approach the entrance on your first visit, with a large size doubt registered in your mind, as did the writer of this article, as to the quality and quantity of the food—not to mention the act of juggling a plate of beans in one hand and a cup of coffee in the other, while you one-stept to a table.

A visit to one of these restaurants proved a revelation. Firstly we find that people of all classes dine here—doctors, lawyers, merchants, shoppers, actors, actresses, et cetra. As you enter the Automat make sure that your supply of nickels is generous. If not the young lady cashier will cheerfully shell out twenty buffalos for a green-back, and start you on your way.

The hot and cold dishes are found in individual groups, properly labeled, so that you soon locate the pie division as well as the soup, sandwich, pastry, coffee, tea and chocolate, and special order sections. These, and many more are distributed along the walls of the restaurant, with the tables occupying the floor except for a space of about six feet in front of the food machines, thus giving free accessibility.

The machines are practically all electrically operated, their functions being performed automatically as soon as a coin is inserted in the slot and the knob on the side is turned. This causes the small glass door in front of the piece of pie, for instance, to become released. You simply push the door up and remove the plate containing the pie. Americans are notorious pie eaters, but don't entertain the rash idea that you can waltz up to one of these mute waiters and mulct a *special* cut of your favorite pie from out of one of its five specimens exhibited. It simply can't be did—Oscar! Why? Oh, just because the head chef has invented a pie cutting machine of deadly accuracy and it cuts five sectors of the luscious mince, each sector having a guaranteed angularity of 72 degrees — no more—no less. But the pie *is* good—ask us—we sampled it.



Front and Rear Views of the Automatic "Special Order" Board. Patron (Left) Inserts Coins and Receives Oven Check; Chef (Right) Sees Order Flashed Up; When Ready He Puts It In Proper Oven (At Extreme Right), from Which the Patron Removes It.

While we common humans will probably never attain such proficiency in the art of food juggling that we can move down the center aisle with five beef stews in one hand and six cups of coffee in the other it is interesting to study the modus

(*Continued on page 939*)

Timing Camera-Shutter Movements Electrically

AN ordinary arc lamp and a small specially governed motor have enabled one of the leading camera manufacturers to develop in its research laboratory a simple camera-shutter testing outfit which projects images of the shutter opening at intervals of a thousandth of a second on a strip of motion-picture film, with exposures for each image of only *one thirty-thousandth of a second;* a period of time so infinitesimal that one's conception of it is at the best vague and undefined. In other words, one can get a clear-cut picture record of the shutter aperture every one-thousandth of a second standing still, so to speak, just as one would obtain a snap-shot of a slow-moving object. With such a record the rate of opening and closing of the shutter and the shutter efficiency can be accurately determined and thus improvements in design made whenever possible.

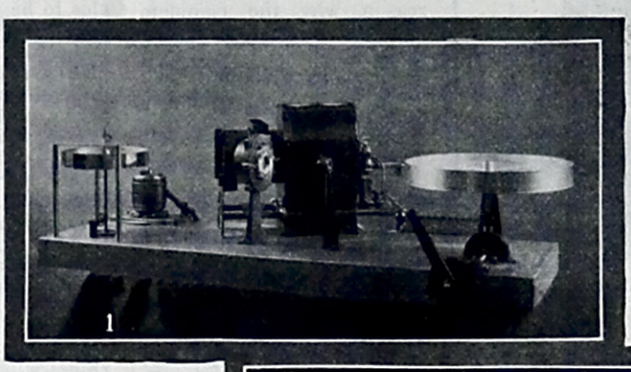
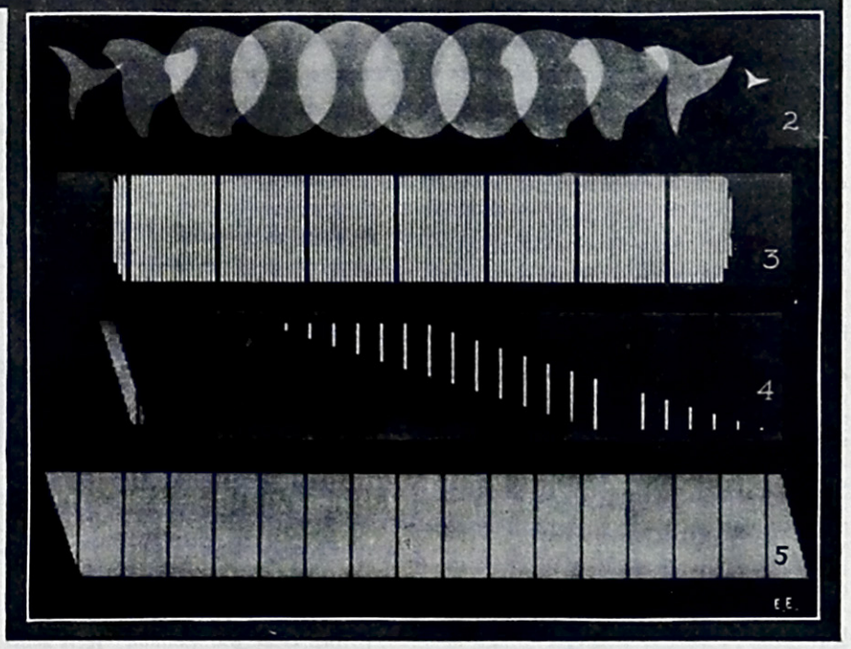


Fig. 1 (Left)—A Simple Motor-Operated Camera-Shutter Testing Outfit Which Shows at Intervals of a Thousandth of a Second the Shutter Apertures With Exposures of Only One-Thirty-Thousandth Second. This Remarkable Scientific Apparatus Enables Camera Manufacturers to Readily and Accurately Determine the Weak Points of Their Shutters, So That Every Part and Function Shall Become a Matter of Standardization.

Figs. 2, 3, 4 and 5 (Below)—Images of "Between-the-Lens" and "Focal-Plane" Camera-Shutter Openings. Each Image Represents the Stage of Opening at a Certain Thousandth-Second Interval. Once Upon a Time the Camera Man Told Us a Shutter worked at 1/1000 of a Second and We Had to Believe Him!



The assembled apparatus is shown in Fig. 1 mounted on a cast-iron base. The arc lamp is enclosed in an ordinary projection lantern, the condenser of which focuses an image of the arc-light crater on the surface of each of twenty small mirrors as they are rotated and which are mounted on the rim of a wheel as shown, which is revolved at a speed of 50 revolutions per second by a specially governed electric motor. The light which is reflected passes thru a simple lens, back of which is placed the shutter to be tested. An image of the shutter aperture is then formed by a small camera lens on the rim of an aluminum wheel, 12 inches in diameter, around which is fastened a band of motion-picture film. The motion-picture wheel is turned by a hand crank and is enclosed in a light-tight box which can be readily removed and taken to a dark room for loading and development.

Since the wheel containing the mirrors rotates fifty times a second and there are twenty mirrors, there are 1,000 interruptions of the arc lamp beam per second. The light from the lantern passes thru a narrow vertical slit before impinging on the mirrors. This slit reduces the angular width of the light flashed thru the shutter to one-thirtieth of that of the angle subtended by one mirror. The time of exposure is, therefore, one thirty-thousandth of a second and a flash is made every one-thousandth of a second.

The results of tests on *between-the-lens* and *focal-plane* shutters are very clearly shown in the photographic records illustrated in Figs. 2, 3, 4 and 5. Fig. 2 is especially interesting since it shows the positions of a between-the-lens shutter set for an exposure of 1/100 second at various stages of opening and closing and records accurately to within one-thousandth of a second the period of full aperture. As can be seen four one-thousandths of a second were required to come to a full opening and three one-thousandths of a second to close while the leaves were fully open for four one-thousandths of a second. The record also shows that altho nominally open for one-hundredth second the shutter was actually open eleven one-thousandths second.

When it comes to recording the speed of shutters open for one-tenth, one-fifth and one-half second, the image on the film is narrowed down by means of a slit inserted in front of the box in which the film is enclosed. This is done because there are only three feet of film and only about fifty images can be taken without serious overlapping. To facilitate the counting of the hundreds of images obtained at the lower speeds one mirror is painted black; thus the images are given in blocks of twenty with one blank as shown in Fig. 3, which illustrates images taken with a between-the-lens shutter set for an opening at one-fifth second. The records shown in Figs. 4 and 5 were taken with a focal-plane shutter set for a short and long opening respectively. By drawing a straight line at right angles to the slit images shown in Fig. 4 the number of points at which the line is cut by the slits determines the extreme number of thousandths of a second the slit of the shutter is passing across a given point on the plate. In this case the line intersects eight slit images, showing the total exposure is eight one-thousandths of a second.

PRESIDENT WILSON PAYS TRIBUTE TO THOMAS EDISON

In excellent health, Thomas A. Edison celebrated his seventieth birthday on February eleventh. On February tenth, a testimonial banquet was given to him at which a letter from President Wilson regretting his inability to be present excited an impressive demonstration of patriotism by officials and employees of the Edison affiliated industries.

"I wish with all my heart that I might be present to take part in celebrating Mr. Edison's seventieth birthday," President Wilson wrote.

"It would be a real pleasure to be able to say in public with what deep and genuine admiration I have followed his remarkable career of achievement. I was an undergraduate at the university when his first inventions captured the imagination of the world, and ever since then I have retained the sense of magic which what he did then created in my mind.

"He seems always to have been in the special confidence of nature herself. His career already has made an indelible impression on the history of applied science, and I hope that he has many years yet before him in which to make his record still more remarkable."

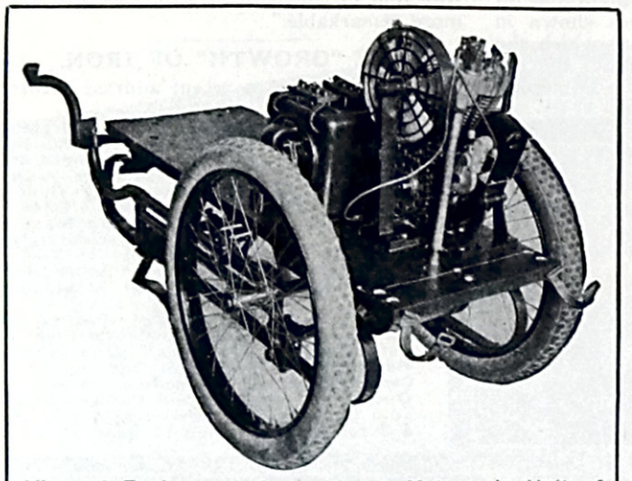
THE "GROWTH" OF IRON.

In the course of a recent address before the South Staffordshire Iron and Steel Institute, Prof. H. C. H. Carpenter gave some interesting examples of the growth of cast-iron. A cast-iron steam turbine case has been known to grow 7 per cent, which naturally had a most pre-judicial effect on its efficiency; and other troubles, such as the seizing of piston heads have been attributed to the same cause. The phenomena of growth appears to be due to the action of silicon, present as silicid, at the same time as free grafite. When iron containing these ingredients is heated oxidising gases penetrate into and gradually attack the metal chemically, causing it to swell. For many purposes such as for steam valves and turbines, it is, therefore, desirable to avoid the use of cast-iron, cast-steel being now substituted.—*The Electrician.*

Londoners have by now become familiar with lighting restrictions and the advice not to waste electricity widely advertised on hoardings. They have not, however, yet had to suffer the restrictions now being imposed in Paris. According to the *Yorkshire Post,* the stopping of electric elevators and the rationing of light in apartments are now under consideration in that city.

Motorcycle Wireless Telephone Outfit

OUR front cover illustration shows a practical possibility in a wireless telephone set mounted on a motorcycle for military requirements, the motorcyclist here being in radiophonic communication with a military aeroplane. While there are a number of motorcycle radio-telegraphic sets in use by the United States Signal Corps and also by foreign armies, these usually require considerable space and necessitate the using of from two to three motorcycle units to transport the complete equipment, which comprises an engine-dynamo cycle of the type here illustrated, a second cycle unit to carry the wireless receiving apparatus, etc., and a third cycle to care for the collapsible aerial mast and wires.



View of Engine and Generator on Motorcycle Unit of Portable Military Wireless Outfit, as Used by U. S. Signal Corps.

Having in mind the extreme compactness of the modern wireless telephone equipment of the de Forest type as is now available and which is capable of transmitting speech from fifty to one hundred miles with a very small amount of current, we have endeavored to bring out on the cover illustration the practical outcome of suitably combining such a radiophone outfit with the motorcycle engine unit, so as to require the minimum of space for the whole outfit, even to the aerial.

The illustration shows how the radiotelephone motorcyclist is enabled to quickly set up his aerial in order to communicate with headquarters or with aeroplanes equipt with radio apparatus. It will be noted that the rear wheel of the motorcycle is revolving, the frame, of course, being supported sufficiently high above the ground and the engine power being used for driving a small electric generator mounted integral with the balance of the motorcycle machinery, with the current from this generator used to energize the radiotelephone set, which might be of the vacuum tube type, for instance.

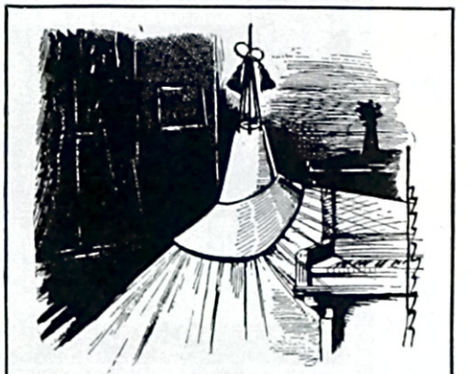
The aluminum collapsible aerial mast is only about five feet high, ordinarily, and telescopes similar to a fishing rod, it being made so as to weigh not more than two pounds. As a matter of fact, some have already been made weighing no more. The aerial itself is also made of thin aluminum wire and is the latest spiral aerial construction interlaced with silk cord, which will make the aerial collapsible also, folding together and taking up very little room when not in use. The entire weight of the aerial is not more than two pounds complete.

The ground wire connects to an aluminum tube tapt at the head for connection purposes, and this is driven in moist ground or earth, this piece not weighing more than about 4 to 5 ozs. The radio outfit itself is attached rigidly to the rear of the motorcycle, behind the saddle, and this outfit does not weigh more than about 12 pounds. For motorcycle purposes it could undoubtedly be made to weigh less by having the box of aluminum sheeting, the weight in this case being not more than four to five pounds.

There should not be any reason why the complete outfit, including putting up aerial, starting generator, testing, etc., should take more than one and one-half minutes from the time of dismounting. There may be some small details which have not been worked out as yet, but they could probably be taken care of without much trouble by the radio engineer of to-day.

"ANTI-ZEPP" SHADES FOR ENGLISH HOMES.

The English lighgting regulations which are now being enforced with considerable rigor have given rise to a demand for shades which will effectually meet the conditions without shutting off more light than is absolutely necessary, says *The Electrician*, London. In order to fill this demand an English manufacturer has put on the market a series of cardboard lamp shades with special features which commend them for general use. These shades, instead of being fixt to the lampholder, are held by cords which are tied to the flexible wire above the lamp at the height necessary to screen the rays from the window. Different sizes and shapes of shade are available, so that their adjustability to all conditions is complete. One form is made with a wide collar shallow towards one side and deep towards the other, so that windows may be fully protected without shutting off much light from the remainder of the room. The collars may also be obtained separately for fixing onto the shades of the other patterns. All these shades are made in various tints, such as dark green, pink, brown, etc.



In "Dear Old Lunnon" It Is Now the Caper to Use Anti-Zepp Shades on All Electric Lights. These Deflect the Light Away from the Windows in the Manner Shown. We Wonder That Liza Will Stand for Such Lime-Light Publicity in Her Own Parlor. Eh, 'Arry?

ELECTROPLATING PLUS.

By Thos. W. Benson.

Electroplating plus machine accuracy is obtained by the use of a new electroplating machine that accomplishes mechanically all operations performed by manual means in the common *still* process of plating. The machine shown in the attached illustration removes to a great extent the human factor in plating operations, which is naturally a great improvement in itself, regardless of the other advantages of the machine as regards more uniform deposits.

The machine is far from being complicated and its mode of operation is obvious. The tanks containing the cleaning, rinsing, dipping and plating solutions are arranged in an oval some thirty feet long. The articles to be plated are past from one bath to the other by means of cam actuated rods instead of by hand. Accurate timing of the plating is obtained by varying the speed of the endless chain that carries the rods, thus giving perfectly uniform deposits.

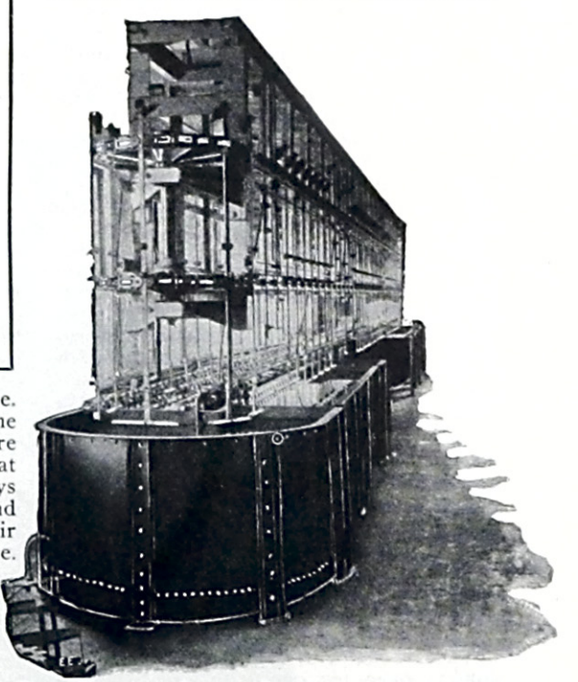
The articles to be plated are hung on racks as shown in the foreground and attached to the rods. After making one complete circuit of the tanks and returning to the starting point the plating is completed. For all ordinary work it takes about one hour for a complete circuit of the tanks; higher speeds would naturally give a lighter deposit, while lower speeds give a heavy deposit on the articles.

It requires but 1 H.P. to operate the machine, which can be easily installed in existing plating plants with a minimum expense of time and labor.

The machine may be adopted to special purposes by a modification of the cam mechanism and the number of tanks. This being made possible by the standardization of all parts.

In addition to the time saved by this machine in transferring the articles from one bath to another, it likewise allows of higher current densities being used without burning the deposit. This is due to the constant agitation of the plating solution by the moving racks.

Altho intended expressly for electroplating it seems highly probable that with modifications it could be used in various other lines, such as cleaning and lacquering small brass parts, or bleaching and dying yarn and similar products.



This Monster Electro-Plating Machine Does Everything but Think. The Articles to Be Plated Are Suspended on Racks Which Move In and Out of the Different Baths Automatically.

The device marks another important step forward and illustrates in a marked manner the trend of modern industry toward simplified processes and the elimination of time losses.

New Suspended Elevated Railway System

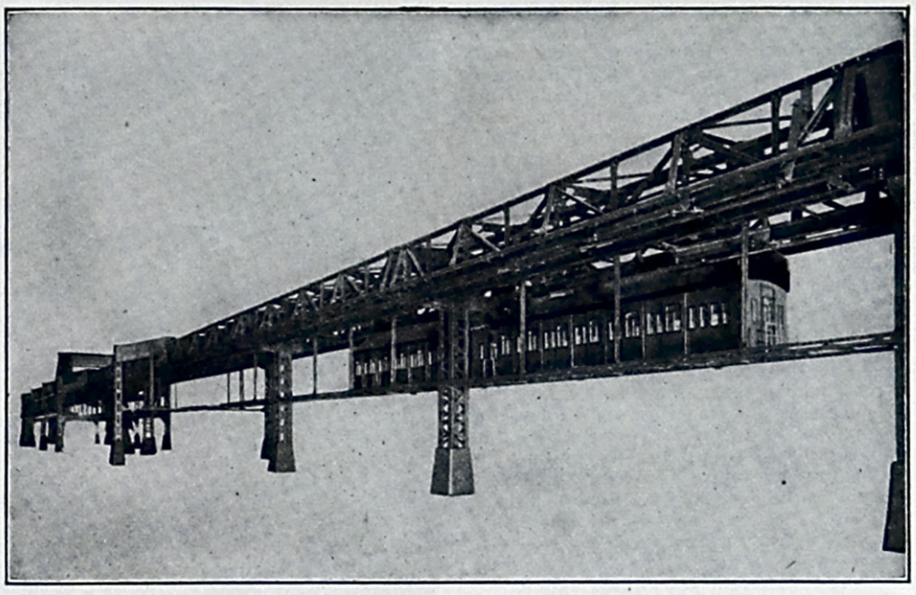
WHILE we are accustomed to seeing the ordinary elevated railway system as installed in many large American cities, such as New York, Boston and Philadelphia, we are inclined to stop and blink our eyes a moment when the proposal is made that instead of having the cars run along on top of the rails, that they be suspended downward from the rails with the wheels and motors secured to the roofs of the cars. A similar system has been in use in Germany for a number of years and possesses many marked advantages, one in particular being that the cars can negotiate or swing around sharp curves much easier and more freely, as well as more noiselessly, than in the usual elevated railway system with which we are familiar.

The newly proposed inverted, electric elevated railway system illustrated by the accompanying views is known as the Strauss system. The promulgators of this new railway claim many advantages for their design of railway among which we find the following:

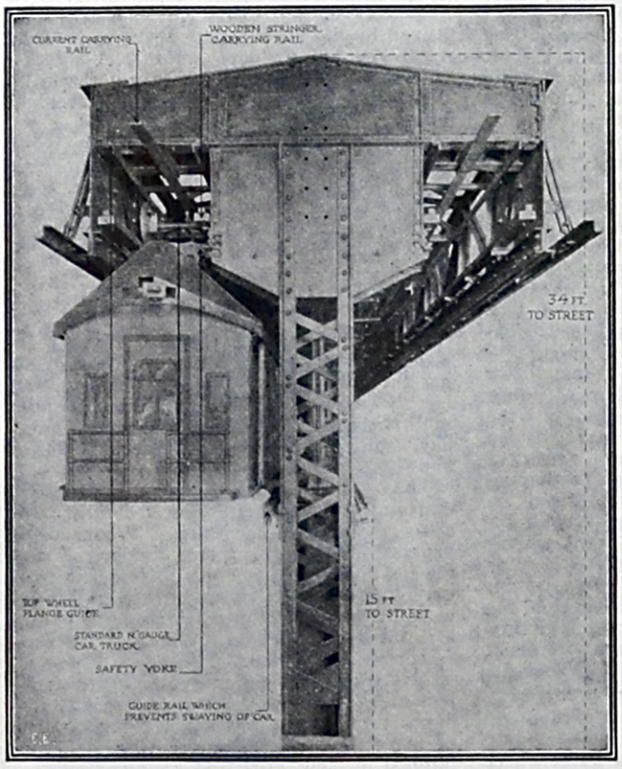
To begin with the Strauss inverted elevated railway does not occupy as much space as the usual elevated system in the street, which is a very important consideration, of course; the new system providing for the suspension of the cars from standard narrow gage trucks that are run on two rails in such a manner that should the trucks or the connection between car and truck fail, the car cannot drop to the ground. Moreover, the track supporting system is of the single post type with provision for a double track system, which effects a maximum economy of street space and particularly, a minimum darkening of the streets and also the smallest possible property damage.

The cars are prevented from oscillating by means of special shoes on the bottom of the car, which ride on a guide rail that extends from post to post. The motion of the car is claimed to be smooth, steady and rapid. The sectional view here presented shows how the electric current is fed to the moving cars thru an insulated third rail above the cars, and which construction has the distinct advantage that in case of an accident or a blockade, when the passengers might have to leave the cars and walk along the guide rail to the nearest column, down which they could descend to the street, there would be no danger from a live third rail, as is the case with the present elevated railway systems.

The track wheels of the cars are flanged and are effectively prevented from running off the main rails by the auxiliary guides, as clearly shown in the sectional view. The inventors of this inverted electric railway also claim that they have provided for the practical elimination of all ordinary noises. This is a very interesting consideration and among the methods by which the engineers intend using this system to accomplish this end are the following:—first by the nature of the track supports which eliminates ties or the ordinary tie floor; by interposing between the track supports and the steel structure, sound deadening material, which is possible in this design owing to the fact that such material will not be exposed to the weather; by filling in the supporting posts with concrete; by the use of a silent wheel, which is said to have seen long use on railways in Russia and finally by the proper enclosure of the driving mechanism.



Appearance of New Suspended Elevated Railway System Developed by an American Engineer. Many Distinct Advantages Are Claimed for This Design, Including Lower First Cost, Greater Accessibility to Passengers, Freer Locomotion, (Particularly Around Curves) and Less Darkening of Streets.


CURRENT CARRYING RAIL
WOODEN STRINGER CARRYING RAIL
34 FT TO STREET
15 FT TO STREET
TOP WHEEL FLANGE GUIDE
STANDARD N GAUGE CAR TRUCK
SAFETY YOKE
GUIDE RAIL WHICH PREVENTS SWAYING OF CAR

Sectional View of New Suspended Elevated Railway with Single Column Supports. The Electric Motors Are Mounted on Top of the Cars Instead of Underneath Them. The Live "Third" Rail Is Above the Car, Not Beside It.

There are many other advantages claimed for this novel arrangement. The inventors mention that passengers would have to climb 9 feet less than ordinarily required in other elevator structures to reach the car entrance platforms.

No less important is the provision for the loading and unloading of passengers. In the Strauss system there are separate entrance and exit platforms at each station, so that the passengers *entering* do not encounter those *leaving* the cars. This not only prevents confusion, but greatly reduces the time of loading and unloading, which is now one of the principal causes of delay in all city traction systems.

The above features, together with the small space taken in the city streets, i.e., single line of posts about thirty inches square, sixty feet apart and in the center of the street, and the practical elimination of the darkening of streets by the carrying structure except at stations, are worthy of special consideration among the many advantages offered.

A most important consideration in connection with this elevated railway is the cost of construction, which is approximately $150,000 per mile less than the cost of the ordinary double-track elevated railways, as we know them to-day. Where these ordinary systems are provided with solid concrete floors, the disadvantages in respect to cost when compared with the Strauss railway are still greater.

The economy of such a railway, in construction is due principally to the following:—the suspension of the cars, which permits a lighter car construction and consequently reduces the dead weight thruout; the projection of the car into the space between the girders which results in min-

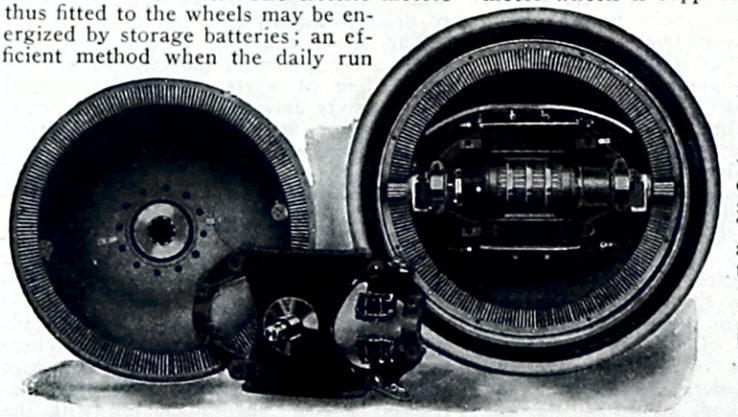
(*Continued on page 931*)

AMONG the hundreds of new devices and appliances publisht monthly in The Electrical Experimenter, there are several, as a rule, which interest you. Full information on these subjects, as well as the name of the manufacturer, will be gladly furnisht to you, free of charge, by addressing our Technical Information Bureau.

NEW IN-BUILT ELECTRIC MOTOR WHEELS FOR AUTOS.

The average, and in fact most all gasoline auto trucks, drive thru their two rear wheels. However it has been found that when the total weight is evenly distributed over all of the drivers that a maximum tractive effort is attained. An example of this principle is seen in the design of modern locomotives. One of the four-wheel drive and steer designs which has been adapted to use on trucks for loads from three to ten tons makes use of four electric motors, which are ingeniously slung in the wheels themselves. The accompanying illustration shows the method of locating the motor between the two concave disks which serve as spokes and motor guard at once. On the opposite ends of the motor are two gears, alike and equidistant from the center or pivoting point of the motor. One of these pinions meshes in one of the big gears carried at the perifery of the large disks, and the other, on the opposite side, with the other gear on the second disk. It is thus evident that, as the motor revolves, one pinion *pushes down* on one gear as the other *pulls up* on the second gear, thus equalizing the strain and distributing the pulling effort evenly. The wires carrying current to the motor are brought in thru the axle and thus are thoroly protected. Hand holes are provided in the disks to permit access to the motors but they are so designed that they will run under very difficult conditions without overheating or developing other motor troubles. Each motor has a rating of three horsepower with an overload capability of 200 per cent, giving the truck a possible horsepower of 36 in an emergency—and of this amount 97 per cent, or approximately 35 horsepower, is delivered to the wheels at a point where it will do the most good—at the rim.

With the motive power thus direct geared to the wheel, with a 25 to 1 gear ratio, there is no transmission to contend with, and the problem of steering with all four wheels is simply a matter of linking steering arms so that all four wheels are controlled by the steering wheel, as all four wheels are mounted on swivels with the power wires leading in thru the spindles. The four-wheel steer gives a much shorter turning radius than it is possible to obtain with a front-wheel steer, and thus gives the truck greater mobility on crowded or narrow streets. The electric motors thus fitted to the wheels may be energized by storage batteries; an efficient method when the daily run does not exceed 40 or 50 miles.



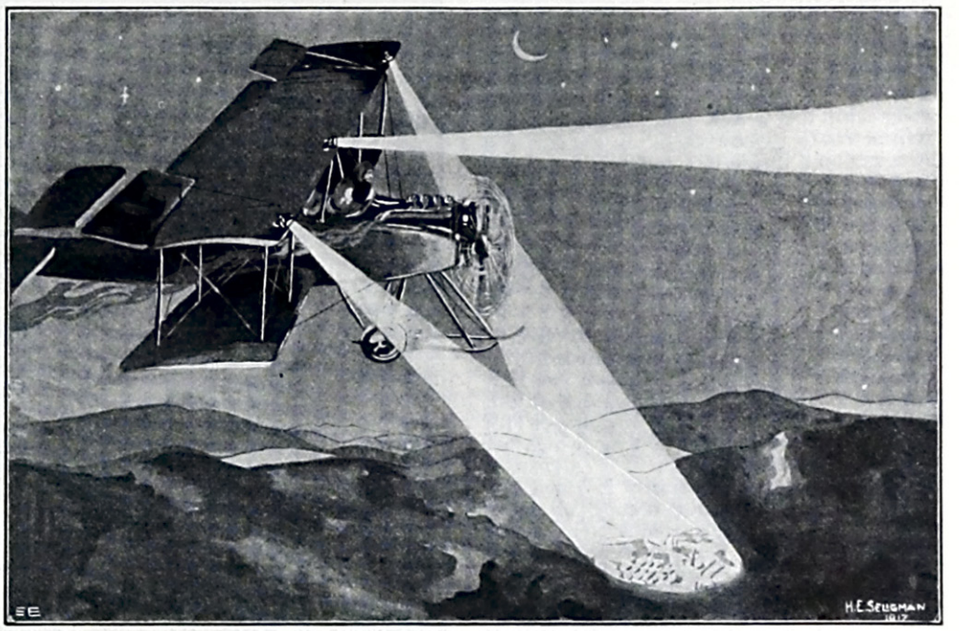
Power Wheel of the Gas-Electric Motor Truck. Illustration Shows Front Disk and Side of Motor Removed Giving Ready Access to All of the Moving Parts.

In some cases a gasoline engine is direct connected to a suitable dynamo (allowing the engine to run at constant speed) from which the current necessary for the four motor wheels is supplied thru a drum type controller. It has been found practicable to install two of these motor wheels on the front axle of an ordinary truck or wagon, supplying current from a storage battery. The rear wheels are the regular truck or wagon wheels. The superior flexibility of such a drive system is apparent.

Night Flying Now Made Possible

To reduce the dangers of night flying the Sperry Gyroscope Company has perfected a lighting outfit, to be carried in addition to the full equipment of automatic control devices, safety appliances and other instruments to insure the pilot a sufficient amount of safety. Three 50 candlepower searchlights are attached to a special fitting on the upper entering edge of the biplane which Mr. Lawrence Sperry has been using in night flying experiments at Amityville, L.I., for the past few months.

The searchlights are mounted in parabolic reflectors which, it is claimed, increase the candlepower to 40,000 for each lamp. The fitting which secures the lamps to the upper plane is designed so that it can be tilted in the vertical plane by turning a knob, which is placed within easy reach of the pilot's hands. This device may be used as a means of signaling, and the lights can be made to focus on any given point, when the pilot is ready to make his landing.



Lawrence Sperry, the Well-Known Inventor of the Automatic Aeroplane Stabilizer, Has Recently Accomplisht Some Excellent Night Flying by the Aid of Three Powerful Electric Searchlights. These Proved Invaluable In Selecting a Landing Spot.

The electric current is supplied by a generator of 150 watts capacity, which is driven by the air pressure at approximately 4,000 revolutions per minute. A storage battery is provided which is automatically thrown into circuit, in case of an accident to the generator.

The machine Mr. Sperry has been using is also equipt with the Sperry automatic pliot and synchronized drift indicator. This drift set was of great advantage to Mr. Victor Carlstrom in his flight from Chicago to New York.—*William Shannon.*

What is reported to be the largest Pelton water wheel constructed in England has been built by James Gordon & Company, British manufacturers, for the Kinlochleven station of the British Aluminum Company. It develops 3,500 H.P.

A.I.E.E. HOLDS MIDWINTER CONVENTION.

The midwinter convention of the American Institute of Electrical Engineers, lasting three days, was held in the Engineering Societies Building, 33 West Thirty-ninth Street, New York City, on Wednesday, Thursday and Friday, February 14, 15 and 16, 1917.

The convention opened Wednesday morning at ten-thirty and technical sessions were held each day. Wednesday's papers dealt with protective devices and the heating and temperature of generators. On Thursday three papers on electrophysics were presented at the morning session, and a lecture was given in the evening by Professor R. A. Millikan on "Modern Physics." Friday's sessions were devoted to the subject of a-c. and d-c. motor control. Thursday afternoon was set aside for a number of inspection trips to points of engineering interest in New York and vicinity.

The convention closed with a subscription dinner-dance at the Hotel Astor, New York, on February sixteenth. A large gathering attended the dinner-dance, which was greatly enjoyed by all.

DATE OF ISSUE.—*As many of our readers have recently become unduly agitated as to when they could obtain* THE ELECTRICAL EXPERIMENTER, *we wish to state that the newsstands have the journal on sale between the fifteenth and the eighteenth of the month in the eastern part of the United States and about the twentieth of the month west of the Mississippi River. Our subscribers should be in possession of their copies at these dates. Kindly bear in mind however, that publications are not handled with the same dispatch by the Post Office as a letter. For this reason delays are frequent, therefore kindly be patient and do not send us complaints as to non-arrival of your copy before the twenty-fifth of the month.*

AN ELECTRIC MOTOR BOAT IN FIVE MINUTES.

The electric motor boat has always met with high favor on account of its noiseless working and cleanliness. In view of the success that the outboard motor has met, it is not surprising that an electric outboard motor has recently been placed on the market.

This outfit, which is illustrated herewith, is manufactured by a Chicago concern. The machine is of particular use in cases where simplicity of operation is desired, while for duck hunting or trolling a boat fitted with one of these little motors would prove ideal. As regards general layout, the machine closely resembles the conventional type of gasoline-driven outboard motor, being clamped to the boat in the usual manner.

The motor is placed directly above the main driving shaft which is contained in a telescopic tube, allowing the propeller to be adjusted to the correct distance beneath the surface of the water. The propeller is driven thru a modified type of worm gearing, which gives great speed reduction between the motor and the propeller, this being necessary, owing to the fact that the normal speed of the motor is about 3,000 revolutions per minute. Above the motor is a small steering wheel, which enables the propeller to be turned to the right or left hand, or completely around, if it is desired to reverse the direction of the boat. To this wheel may be fitted either a tiller or steering yoke, according to requirements. The outfit is made of aluminum and manganese alloy wherever possible, the idea being to reduce the weight to a minimum. The motor complete, but without battery, weighs only 50 pounds.

The armature of the motor runs on ball bearings, and the commutator and brushes are of special design, suitable for low voltages, as the motor is used with a storage battery of 6 to 12 volts. By means of a simple device the motor may be detached from the driving shaft and used for other purposes where power is required, the current being derived from the batteries in the boat. The standard storage batteries supplied with the regular equipment are two batteries of six volts, 120 ampere-hours each, but the manufacturers can supply a range of accumulators of 6 to 12 volts, having a varying capacity of 60 to 120 ampere-hours.

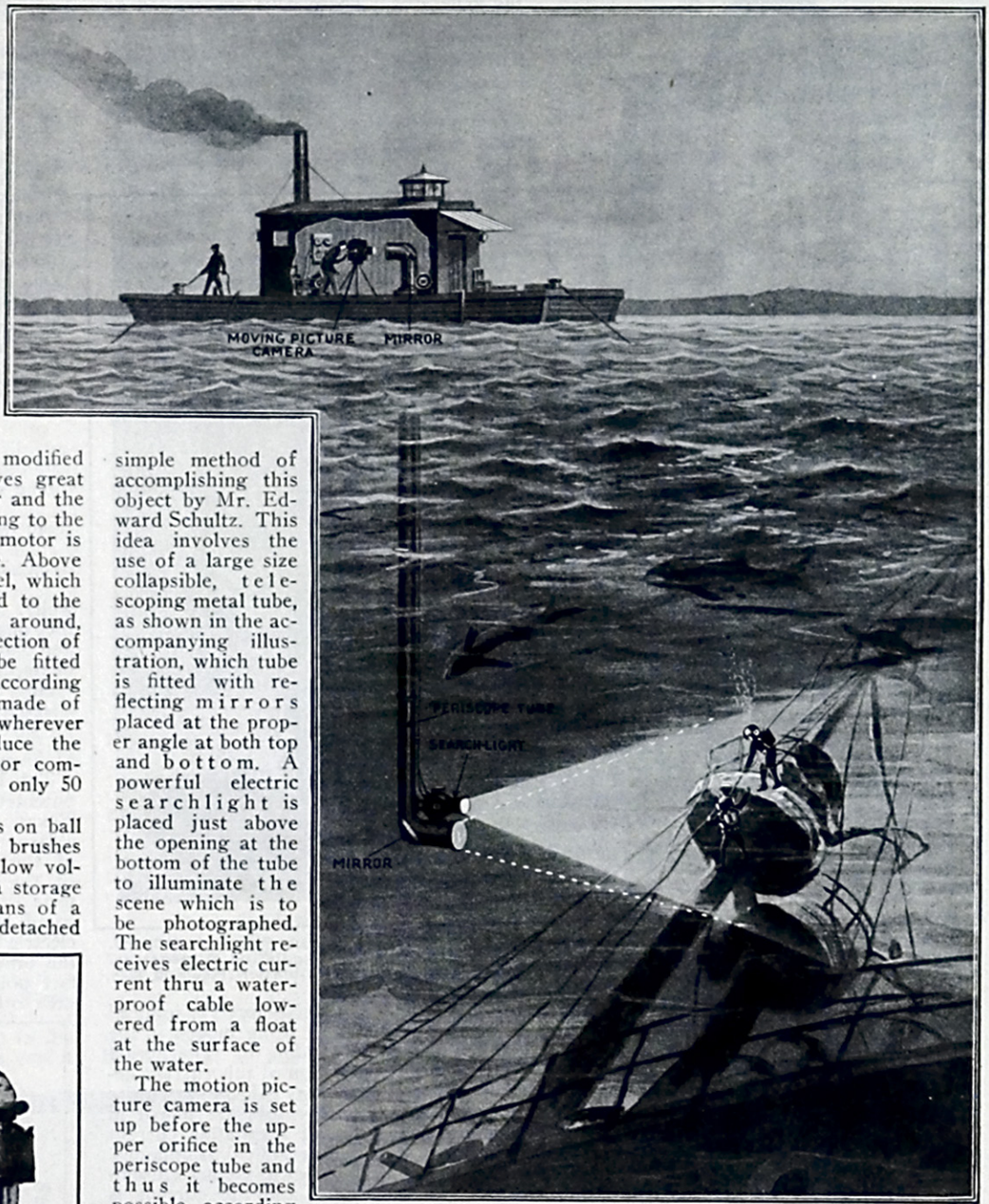
Here We Have the Electric Motor-Propeller Which Makes Any Boat a Motor-boat in Five Minutes. It Runs on a Small Storage Battery and a Child Can Operate It.

A NEW IDEA FOR TAKING SUBMARINE "MOVIES."

WHILE there are a number of schemes in existence for taking submarine motion pictures, we have recently had submitted a unique and simple method of accomplishing this object by Mr. Edward Schultz. This idea involves the use of a large size collapsible, telescoping metal tube, as shown in the accompanying illustration, which tube is fitted with reflecting mirrors placed at the proper angle at both top and bottom. A powerful electric searchlight is placed just above the opening at the bottom of the tube to illuminate the scene which is to be photographed. The searchlight receives electric current thru a waterproof cable lowered from a float at the surface of the water.

The motion picture camera is set up before the upper orifice in the periscope tube and thus it becomes possible, according to Mr. Schultz's invention, to readily photograph the subaqueous flora and fauna, as well as any other moving objects such as divers, fishes, etc.

Electrical energy for operating the searchlight is obtained from a small dynamo driven by a steam or other engine mounted on board the vessel at the surface of the water. While this scheme apparently loses a great deal in efficiency owing to the projection and reflection of the scene from one mirror to another, from the optical point of view, still there is considerable merit in the fact that the camera does not have to be submerged in any way. Also, with this arrangement, it is possible to quickly change the view by raising or lowering the periscope, which is also revoluble about its axis, all of which tube movements are cared for by a small quick-acting electric motor and appropriate control apparatus on board the float. The searchlight may also be turned on and off and its power regulated from the float.



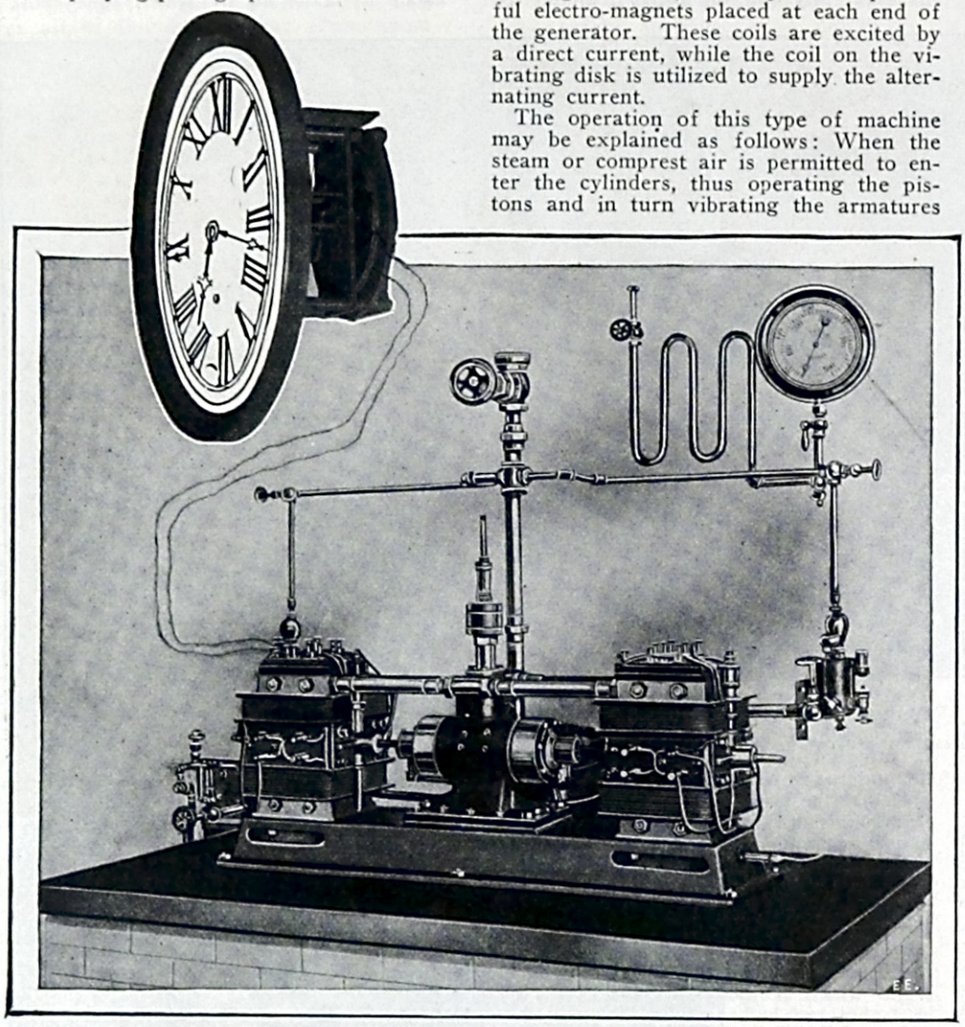
Submarine Motion Pictures Are Very Valuable, Both for Theatrical and Educational Purposes. With the Scheme Illustrated It Becomes an Easy Matter to Take Such Pictures, a Powerful Electric Searchlight Illuminating the Scene, While the Camera Films the Image Projected up the Telescopic Tube.

CANADA'S WATER POWER.

Canada's available water-power, allowing for limitations imposed by international agreements in connection with Niagara Falls, and one or two other sources, amounts to 17,746,000 h.p. Excluding the Northwest Territories and the Yukon, about 1,712,000 h.p. out of this total is already being utilized. If the present rate of progress continues, it is calculated that something like 8,000,000 h.p. will be made available during the next fifteen years.

A Novel Tesla Steam-Electric Clock

Among the various wonderful inventions of Dr. Nikola Tesla we find one of the most interesting clocks ever made, and the accompanying photographs show the necessary equipment for this highly ingenious and novel electric clock.



A Steam-Electric Clock Devised Some Years Ago by Dr. Nikola Tesla, the Electrical Wizard. It Comprises an Air or Steam Engine Which Operates Two Special Oscillating Alternators. These Are Wired Up to a Special Motor on the Clock—the Entire Combination Keeping Extremely Accurate Time, It Is Said.

The clock proper, shown above, is apparently no different from any other standard clock. However, the mechanical movement has been removed and substituted by another special movement linked up with an alternating current motor of special construction which can be seen at the extreme right of the clock. The field consists of a number of rectangular coils placed in torroidal form and connected in series. The rotor or armature is constructed of a circular iron disc, the periphery of which consists of a large number of poles. The speed of this rotor is controlled by the current input. Connections between the rotor shaft and that of the clock hands is obtained by means of a number of reduction gears properly calculated so as to obtain the correct time, when the hands are acted upon by the motor.

The source of current for driving this remarkable electric clock motor is obtained from an alternating current generator of very unique construction and design, this machine being illustrated here. It consists of two steam or comprest air cylinders, built in one frame as shown. A piston is placed in each of the cylinders which operate alternately with respect to each other. The connecting rods of each piston are linked with a vibrating membrane of each dynamo; these are seen at each end. A coil is placed on each membrane and connected to a special commutator. The electro-magnet or coil is operated in a powerful magnetic field, made up of two powerful electro-magnets placed at each end of the generator. These coils are excited by a direct current, while the coil on the vibrating disk is utilized to supply the alternating current.

The operation of this type of machine may be explained as follows: When the steam or comprest air is permitted to enter the cylinders, thus operating the pistons and in turn vibrating the armatures or coils, an electro-motive force is induced in the coil by virtue of being moved in the magnetic field surrounding it. The period or frequency of vibration of this current depends upon the rapidity of the armature movement. Both generators are linked in such a manner that an alternating current of uniform form and periodicity is obtained.

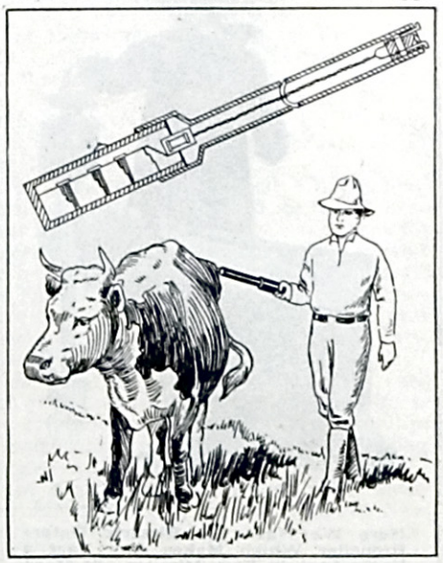
The motor on the clock is connected with this special generator and the current is so adjusted that a uniform velocity of the rotor is always obtained in order to obtain absolutely correct time from the clock.

A large number of such clocks were installed in the laboratory of Dr. Nikola Tesla a number of years ago which are driven by a single generating unit. It is said that the accuracy of time attained by this ingenious clock system is far better than with any other system known.

AN ELECTRIC "PROD" FOR ANIMALS.

The *electric prod* is the successor of the big bull-whip which at one time was so generally made use of by men who had horses and cattle in their charge. The general activity of the societies for the prevention of cruelty to animals with its organization all over the country, has been the means of putting the ugly old bull-whip out of business, for at the present time, it is a rare thing to see them even in the establishments devoted to the sale of harness and such things.

The electric animal prod has just been patented by a resident of Fort Worth, Texas, which has recently developed into a large cattle center, and the prime object of the prod is to hasten the movements of the cattle being past thru the abattoirs of that place. The prod is an elongated body with several batteries and an electric coil concealed in the handle. At the other end of the device are two contact points, spaced a small distance from each other. When this end of the apparatus is applied to the body of the animal, the circuit is established between the two points and the animal experiences an electric shock.



When "Bossle" Becomes Unruly It's an Easy Matter to Hustle Her Along with This New "Electric Shocking Prod."

PROF. CLERK MAXWELL A POET THIRTY-SEVEN YEARS AGO.

The late Prof. Clerk Maxwell was in the habit of recreating his mind from its severer tasks by penning amusing physio-comic parodies of well-known poems. One of the best of these was his electric valentine, which runs as follows:—

ELECTRIC VALENTINE.

Telegraph Clerk A to Telegraph Clerk B.

"The tendrils of my soul are twined
With thine, though many a mile apart;
And thine in close-coiled circuits wind
Around the magnet of my heart.

"Constant as Daniell, strong as Grove;
Seething thru all its depths, like Smee;
My heart pours forth its tide of love,
And all its circuits close in thee.

"O tell me, when along the line
From my full heart the message flows,
What currents are induced in thine?
One click from thee will end my woes."

'Thru many an Ohm the Weber flew
And clicked this answer back to me—
"I am thy farad, staunch and true,
Charged to a Volt with love for thee."

The inscrutable signature $\frac{dp}{dt}$ is adopted from the fundamental equation of thermodynamics $\frac{dp}{dt}$ =J.C.M. (James Clerk Maxwell). This explanation reminds us that the famous colleague physicists, Thomson and Tait, are familiarly known to their students as T. and T., nicknames also drawn from the jargon of thermodynamics.—*Electrician, London.*

ENERGY NECESSARY TO OPERATE A TROLLEY CAR.

It requires on the average about 125 watt-hours per ton-mile to operate a car in city service. Translated into a more comprehensible unit, this is 166 foot-tons. That is, the same amount of energy is required to move the car one mile on the level as would raise it vertically 166 feet. All of this energy goes into heat, part of the loss being preventable, the balance otherwise.

TUNGSTEN LAMPS FOR KANSAS CITY STREETS.

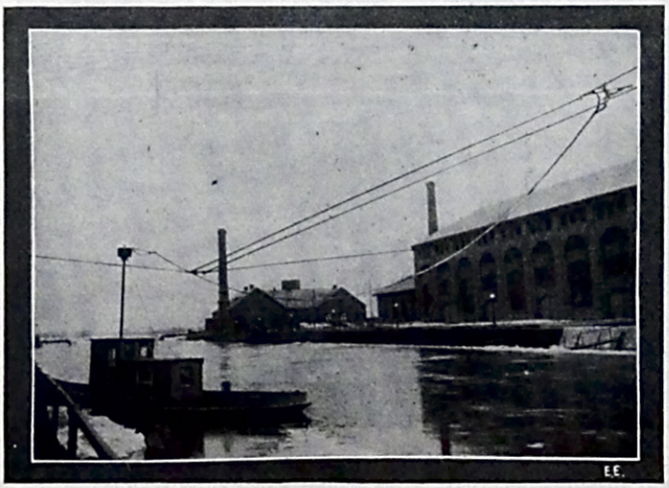
Kansas City is the first large city to replace all of its street arc lights with nitrogen filled tungsten bulbs. Fourteen hundred of the new bulbs, which are now being installed, will save the city, it is figured, more than $30,000 each year. This saving will be invested in providing better lighting facilities for the newer sections of the city.

A NEW AND PRACTICAL TROLLEY BOAT.

By Raymond F. Yates.

The *trolley boat* shown in the illustration is not an experiment, but a practical arrangement actually in use at one of the big power company's plants at Niagara Falls. Ice, flowing down the river from the Great Lakes, has always been a menace to the operations of the power companies at Niagara, and this powerful, electrically propelled vessel is used to prevent ice from jamming in the intake canals, where it causes serious trouble by preventing the proper amount of water from flowing into the penstocks. By means of a perfect control system, this little craft is surprisingly active and darts to and fro with remarkable rapidity, striking the huge cakes of ice and sending them on their way.

The hull of the boat is made of steel, and its power equipment consists of one 75 H.P., single phase, 220 volt, 25 cycle railway motor. The motor is connected to the propeller shaft thru a single train of reducing gears, with a ratio of 16 to 66, which causes the propeller to revolve at 240 R.P.M. at full speed. The maximum speed of the motor is 1,000 R.P.M., and intermediate speeds are obtained by means of a regular drum controller and grid resistances. The power leads are brought in at the top of the small pole as shown in the illustration. The top of the pole is equipt with a commutator and swivel arrangement permitting the vessel to travel in any direction and still receive its necessary power for locomotion.



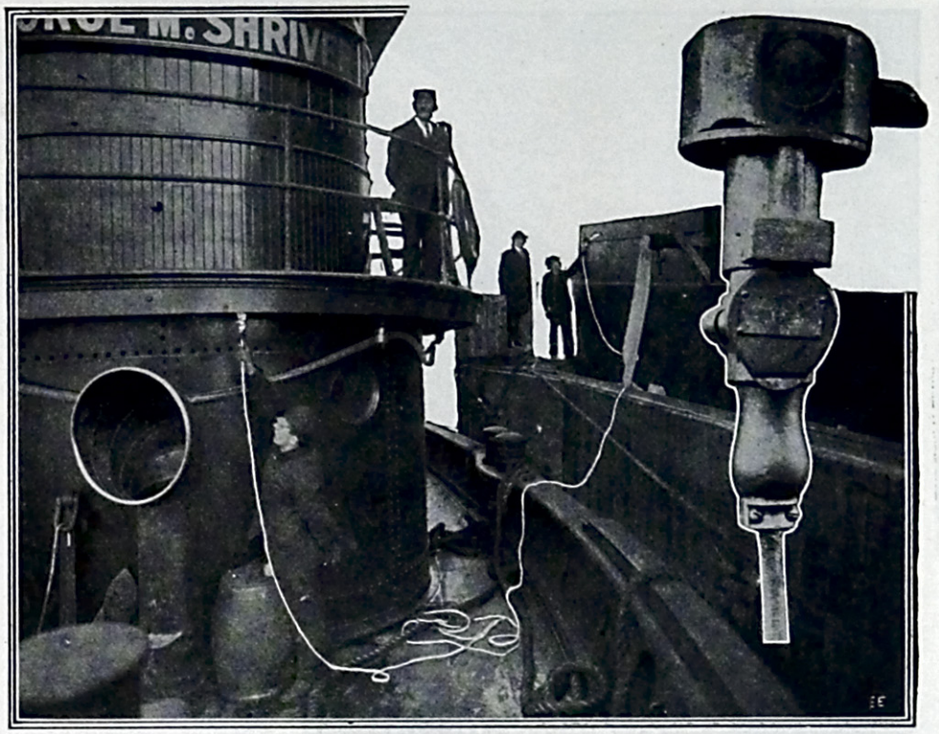
One of the Large Power Companies at Niagara Falls Have In Service Several of These Unique Electric "Trolley" Boats.

Tug Dispatching Via Telephone

The movement of the tugs handling the barges and car floats at the Baltimore and Ohio terminus in New York is controlled at a central point by a dispatcher, who instructs the captain by telephone where to call and the point of delivery, thus saving considerable time.

In order that the captain may more readily communicate with the tug dispatcher, the New York Telephone Company has recently installed for the B. & O. Railroad Company a complete telephone tug dispatching system, whereby the captain of a tug without leaving his boat may communicate directly by telephone with the dispatcher, who is located at St. George, S.I., at any time of the day or night when the tug is at dock. This installation was made by means of regular jack and plug steamer equipment. Common battery telephone sets of the hotel type were installed in the pilot house of each of the ten tugs of this terminal and on two steam lighters.

The instruments are placed permanently and are wired to two permanent jacks on the exterior of the boat, one on the bow and one on the stern. Other jacks are located on the sea end of ten of the Baltimore and Ohio piers at different points in Manhattan, Brooklyn and St. George, S.I., the latter point being the New York freight terminal of this railroad company. The jacks on the piers in New York and St. George are bridged to extension lines connected to the railroad's different private branch exchanges at each place, which boards are connected by tie lines, and the tug dispatcher is thus reached. In Brooklyn the jack at the end of the pier is bridged to an individual line. In this case the dispatcher is reached by means of toll lines to the St. George's exchange switchboard.



The Telephone Is Proving More Indispensable Every Day—Here We See It Adapted to the Requirements of Tug Dispatching At One of the Large Eastern Railroad Terminals. Connecting Jack On Pier Shown Enlarged At Right.

Connections are established by means of a flexible deck cable with a plug on each end, which is carried on each boat. When a boat lands at the dock a member of the crew plugs one end of the flexible cable into one of the jacks on the boat and then goes ashore and inserts the other end into the jack on the dock; the service is then ready for the captain to make a call from the pilot house, the same as from any other extension station. Photo courtesy *The Telephone Review.*

BENEFACTORS!

I doff my hat
To my friend Brewster,
Whose auto killed
My neighbor's rooster.
—*Cincinnati Enquirer.*

We tip our tile
To Colonel Huppy,
Whose flivver slew
Our neighbor's puppy.
—*Macon Telegraph.*

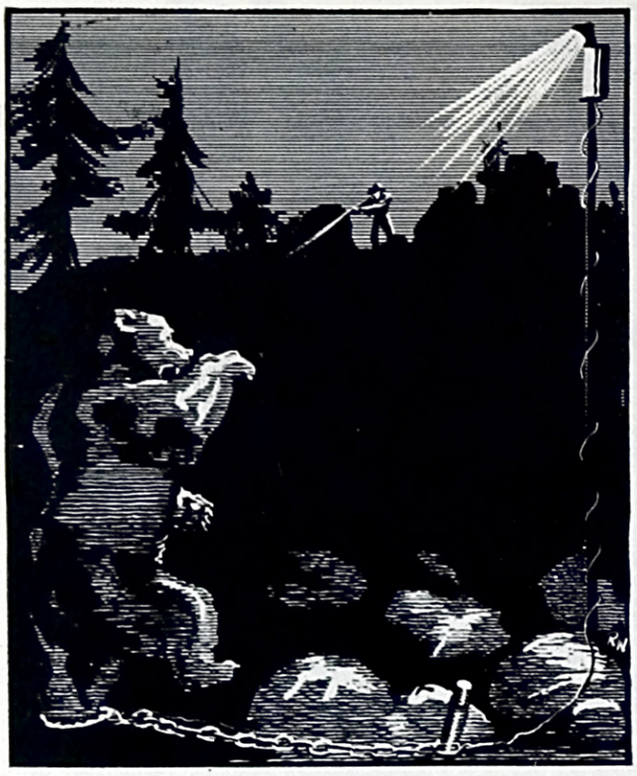
Our chapeau's off
To Ezra Pratt,
Whose twin-six smasht
Our neighbor's cat.
—*Columbia State.*

My lid is doft
To Hiram Prote,
Whose honk-honk got
My neighbor's goat.
—*Yonkers Statesman.*

My stovepipe's off
To Henry Lord,
Whose racer squasht
Our neighbor's "Ford."

ELECTRIC LIGHT FLASHES WHEN ANIMALS ARE TRAPT.

A Western trapper has arranged an electric system which lights a small electric bulb when a trap is sprung, enabling him to locate it in the darkness and shoot the animal. The method of arranging the electric light attachment is shown in the accompanying illustration. In most cases a battery proves the easiest solution of the current supply problem. A simple switch arrangement connected to the trap serves to close the lamp circuit when the trap is sprung.



When Mr. Bear Lands in This Electric Trap a Light Flashes Up, Enabling the Trapper to Readily Shoot the Animal.

THE STRIKING BAG AS A STATIC GENERATOR.

By Bernadotte Anderson.

The other evening I discovered a curious phenomenon when proceeding to work out my usual bouts on the striking bag (or should "punching bag" suit your fancy, we will call it that).

Preferring to get as much outside air as possible, I set up the apparatus for the bag in a shed in the rear of the yard, instead of in the garret or cellar, and where the noise from the bag would not be objectionable.

Having previously noticed how much the air in the bag would contract, due to the extreme cold weather, I decided to detach and hang it in the house, where it would expand considerably under the warm temperature.

It happened to be a cold, crisp and clear evening the next time I made ready to do some more punching stunts and starting to beat up severely on this defenseless exponent of gymnastics, it rebounding with extreme agility under the influence of the heated and expanded air within itself, the curious phenomena of *static electricity* exhibited itself in a marked degree at every stroke of the bag. The room being dark, it was quite an interesting sight to notice the imprint of the hands which manifested itself in electrical impressions at the point of contact. Those who are interested in physics and happen to have a punching bag and can put it thru the role that I did, under the required conditions, should experience similar results.

I assume that the law of physics which made this experiment possible was that the heated air inside the bag was one side of a static condenser; the rubber and leather covering, the dielectric medium, and the hands the other side. Thence, when causing the bag to oscillate rapidly, which corresponded to the frequency of the charging medium, produced the described effects. As the discharge did not take place until after making a few preliminary rapid violent strikes, I also assume the deduction that this was the period when the *condenser* was receiving its initial charge and that every blow of the hand after the point of full capacity charge acted as an overflow discharge between the hands and the bag.

This is one of the numerous incidences where nature's wonderful medium we call *static electricity* exhibits itself in such illusive and fascinating forms, and causes one to pause with the inevitable desire to grasp its possibilities were it possible to harness these ethereal vibrations and store their energy for future service, as readily as man's genius has made it feasible to record the human voice and reproduce at will and to store electrical energy in storage batteries.

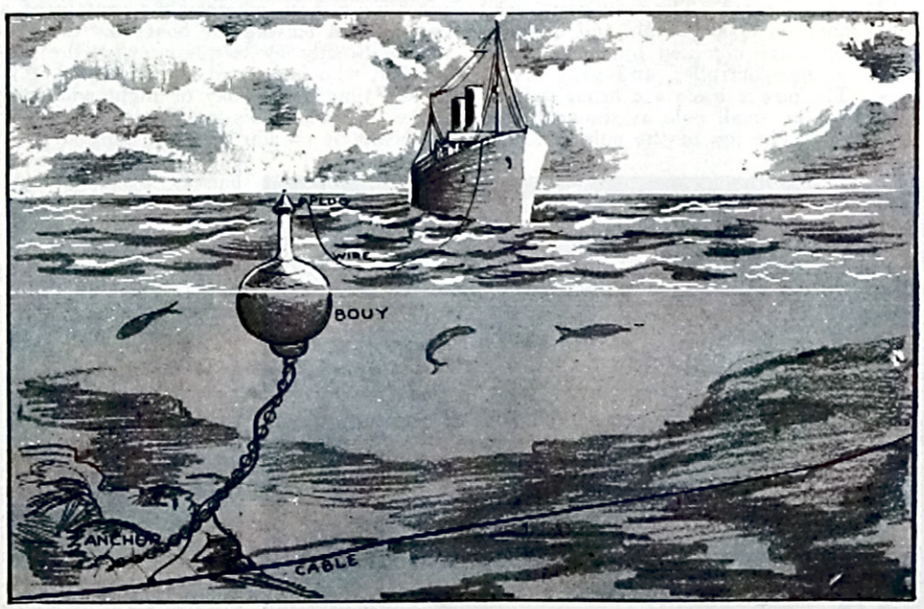
WHY NOT CABLE BUOYS IN MID-OCEAN SO SHIPS COULD TALK TO SHORE?

WHILE we have wireless telegraphy and telephony available for ship to ship and ship to shore communication, it is hardly probable that we shall want to build or lay submarine cables arranged with tap-off junctions every fifty miles or so, connected with buoys floating on the surface of the ocean so that ships might plug in on one of these buoys and communicate with shore. However, it is an interesting thought nevertheless and the scheme has been promulgated by a youthful electrical genius of Buffalo, N.Y., one Edward Schultz.

Mr. Schultz proposes that submarine cables be provided at short distances with a junction box and at these points buoys would be permanently anchored by means of a chain or wire cable in the manner illustrated. A connecting wire runs from the junction box on cable to the buoy.

When the ship wishes to communicate with shore it approaches one of these buoys and lowering a small boat the ship's electrician proceeds to the buoy and establishes the communication between it and the vessel by means of a flexible insulated electric cable, one end of which is secured to the ship, of course, and the other end of which is carried by the small boat to the buoy. When the message has been telegraphed, the reverse procedure occurs, i.e., the ship's electrician goes to the buoy in a small boat and disconnects the cable; after he has returned to the large ship the cable is reeled up on deck and the vessel proceeds on its way.

These buoys could be suitably illuminated at night, so that connection with them could be readily established. The inventor, who is only nineteen years of age, has several other clever ideas in mind for the application of this scheme. He mentions that in time of war the buoys could be suspended or anchored so as to be a short distance beneath the surface of the water and that these locations be marked on the charts carried by the ships of the nation to whom the cable belongs. It would thus be an easy matter to establish connection with the buoy, even tho a diver had to be employed for the purpose. The inventor also advances the idea that it might be possible in this way to transmit electrical energy to vessels for the periodical recharging of storage batteries, presumably for those cases where a ship may have become disabled or for certain other purposes. Electric current, according to the inventor, could also be sent along the cable to light the buoy lamps, ad lib.



Why Not Have Cable Buoys Located Along Steamship Routes Across the Ocean? Says Mr. Edward Schultz, a Youthful Inventor, So That Ships Could Communicate With Shore. Not a Bad Idea.

HOW TO READ YOUR OWN ELECTRIC METER.

By Walter F. Current

A GREAT many persons who have their homes lighted by electricity, know practically nothing about reading their meter. There are a multitude of people who will not pay their grocery account before they look over the bills for mistakes, but they will blindly pay their electric light bill without knowing whether it is correct or not. Your meter reader is human and is just as liable to make a mistake as your grocer. Therefore, everyone should know how to read his own meter, and how to keep a check on his electricity bill. If you do find an error in the bill, you will find that the electric light company will be more than glad to rectify the mistake.

The purpose of this article is to help those who do not know how to read their meters, and to help them to keep a check on their electricity bills. In the first place, perhaps, you would like to know what a *kilowatt-hour* is. The word is made up of three words, namely, kilo, watt, and hour. *Kilo* is a Greek word meaning one thousand, and it is often used in the English language to express one thousand. Thus a kilometer is, in the metric system, one thousand meters. The *watt* is a unit of electric power, and is one thousandth of a kilowatt. The *hour* used is the common hour of sixty minutes. Thus it is easily seen that a kilowatt-hour is simply one thousand watt-hours. Practically a kilowatt-hour is one thousand watts used for one hour, or one watt used for one thousand hours.

Fig.1 Reading 4542

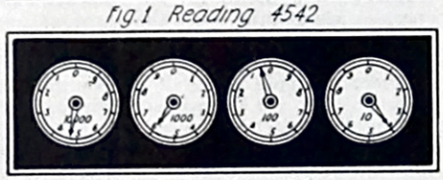


Fig.2 Reading 4604

The meter records the kilowatt-hours on a dial, by means of a clock-work mechanism. This dial consists of three or more circles of figures placed side by side, or in the shape of an arc. Each circle has a pointer which is operated by the rotating element in the meter and which points to the figures on the dial.

Meters are all read alike so we will take one with a dial of four circles for an example. *You begin at the right hand circle* to read the meter, *and continue to the left* until all of the circles have been read. Suppose, for instance, that the pointer in the first circle (right hand) points to 4, the second one to 8, the third to 5, and the fourth to 1. Then, if you have set your figures down in the same order in which you have read them the meter reading will be 1,584 kilowatt-hours. The right hand figure in your result should be the same as the figure which the pointer indicates in the right hand circle, which in this case is 4.

The first circle in the dial usually has the figures reading in a *clock-wise* position, the second in a *counter-clock-wise* position, the third clock-wise, and the fourth counter-clock-wise, as is shown in the accompanying illustrations. In the first example the pointers were all pointing to some definite figure, but suppose that in the second circle, the pointer was between 4 and 5; how can we tell whether to call it 4 or 5? In this case the number which the pointer is leaving is the one to use. Therefore the reading for Fig. 1, is 4,542 kilowatt-hours. For in the first circle to the right the pointer is just leaving 2, and it must be read as 2. In the second, the pointer is just leaving 4, and must be read as 4. In the third, the pointer is just leaving 5 and it must be read as 5. The last circle reads 4.

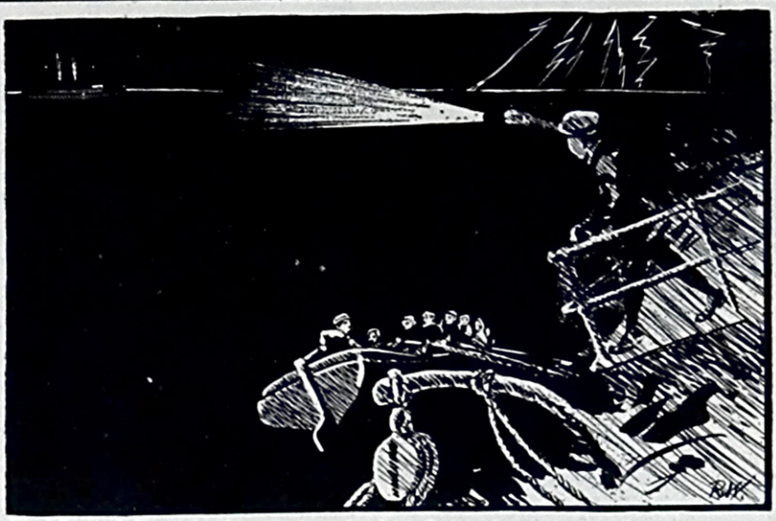
Let us take another illustration. In Fig. 2 the first pointer reads 4, the second 0, the third seems to be pointing directly at 6, but the question is—has it reached 6, is it between 5 and 6, or is it between 6 and 7? If it has past 6 it will be called 6, but if it has not passed 6 it must be called 5. This must be determined by the pointer next to the right. This is half way between 0 and 1, therefore it must be just starting on its trip around the circle, and this being the case, the pointer in question must be just starting to go from 6 to 7. It is just leaving 6. The fourth pointer reads 4, therefore the reading is 4,604 kilowatt-hours.

Let us suppose that the reading in Fig. 1 was your meter reading for one month, and the reading in Figure 2 the reading for the next month. By subtracting the first from the second, we get 62 kilowatt-hours as the meter consumption for this month. Then supposing that the electric light company charged $.09½ per kilowatt-hour, the bill for the month would .09½x62=$5.89. Always note if your meter dial board has any remarks on it giving a factor by which to multiply the dial reading. If it should state—multiply by 4—then you simply have to multiply the reading as found above by 4 to ascertain the net result.

Thus it is seen how easy it is to check up your electricity bill, and I hope a great many of the persons who read this article will be benefited by it.

POCKET SEARCHLIGHT SAVED ELEVEN PEOPLE.

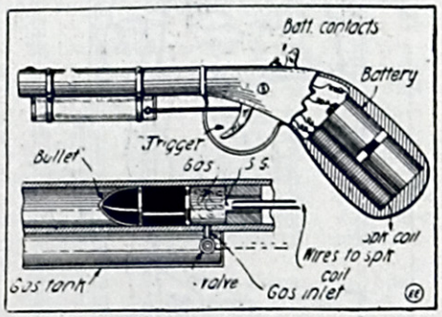
The presence of a young lad with an electric searchlight and a knowledge of the wireless signal code on the steamship *Pio IX* recently led to the rescue of eleven of that ship's company by the steamship *Buenos Ayres*. The captain of the latter vessel saw small, glimmering lights and the signals flashed out by the amateur were translated by the ship's wireless operator. The rescue followed, but not until a large number of members of the crew had been lost in the storm. It was a curious use of the common little electric novelty, but it suggests a method of supplementing wireless service over short distances. With powerful searchlights supplementing the wireless code, the process of near-by signaling would be much simplified.



The Pocket Electric Flash-Light Is Not Only of Invaluable Service In the Home, But In One Instance Served As the Means Whereby Telegraph Code Signals of Distress Were Flashed by a Boy On a Sinking Liner, Saving Many Lives.

THE ELECTRIC PISTOL COMMANDS—HANDS UP!

An inventor has turned out an electric pistol, built along original lines. It does not use gunpowder or cartridges, but is so constructed that its contents, gases, are exploded by a touch of the button and a projectile is expelled. The pistol consists of a brass clinder, at one end of which is a small battery and coil. The gases are introduced from the outside or from a small tank attached to the pistol frame. Altho the use of electricity in this case is merely an experiment, it is evident that it can be used to produce exactly what powder does, explosion in a confined space and the swift movement of a missile. Mankind began with a club and a stone to deliver blows. The bullet is only a smaller but speedier object than a hand-thrown stone, wounding at a greater distance than is possible with a spear or arrow.



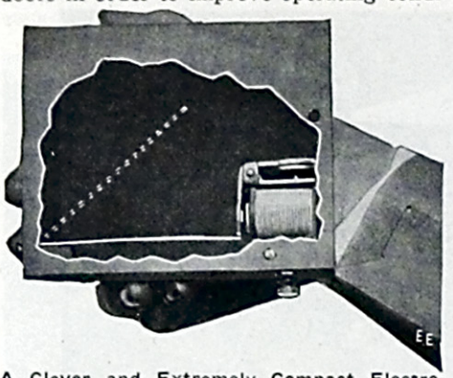
The Electric Pistol Is the Latest—An Electric Spark Ignites a Charge of Gas, the Explosion Forcing the Bullet Out of the Barrel.

RADIO MESSAGE SENT 112 MILES FROM AEROPLANE.

Emil J. Simon, a radio engineer of New York City, temporarily attached to the Army aviation school at San Diego, Calif., with Captain Herbert A. Dargue as pilot, sent a radio message from an aeroplane over a distance of 112 miles to the receiving station at the school.

CONTROLLING THE FURNACE DRAFT ELECTRICALLY.

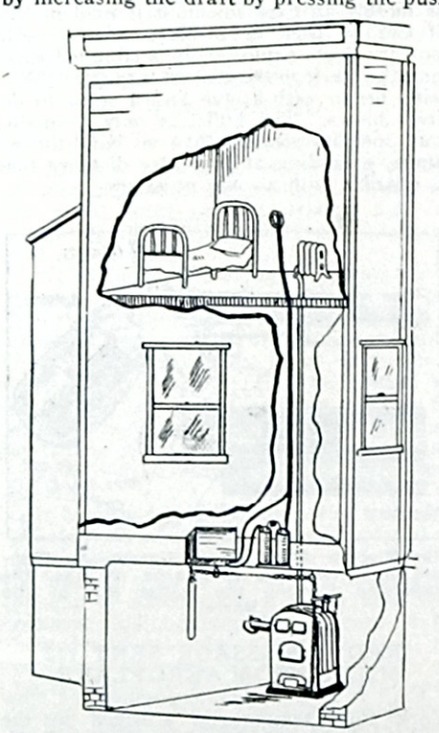
One will admit that it is very inconvenient for the housewife to be forced, especially in cold weather, to adjust the draft doors in order to improve operating conditions. This inconvenience has been overcome by Mr. Walter Hann, who employs a very simple, yet ingenious electro-magnetic device for this purpose. This is shown in the photograph and consists of nothing more than a flat iron bar pivoted on one end of which is a hook to hold a weight. Normally this bar is kept in an horizontal position and held there by means of a pivoted armature, supported on an electro-magnet as shown. This magnet is connected to two dry batteries and a push button. The connections are made from the two binding posts at the bottom.



A Clever and Extremely Compact Electro-Magnetic Device which Automatically Opens the Furnace Drafts.

The iron weight attached to the arm carries a chain which is past thru a pulley and connected to the draft door of the stove or furnace. A schematic diagram of such an installation is given herewith, which shows clearly the manner in which the electrical draft control is attached and its main accessories.

Its operation is very simple and may be explained as follows: Suppose that more heat is necessary; this is compensated for by increasing the draft by pressing the push button stationed anywhere in the house; the electrical circuit of the battery is completed and the electro-magnet in turn attracts its armature, which releases the long arm. The weight, which is appended to the arm is caused to drop, which, in virtue of its mechanical connection with the draft door, opens it automatically and in this way permits more air to enter the fire box. This naturally increases the temperature of the furnace and consequently more heat is obtained.



Section of House Showing Automatic Electric Control of Furnace Draft Installed. A Push Button Beside the Bed Actuates It.

HOT WATER BY ELECTRICITY IN 8 SECONDS.

Mother certainly has cares enough without being constantly aggravated and inconvenienced by having no hot water when she wants it most. Be it the fault of the janitor or of the old-fashioned water-back on the range or gas stove, or perhaps the lack of any heater, the result is always the same—she must resort to the tedious process of heating a small quantity of water in a kettle. This takes time, and when the supply is used up, she must boil another kettleful and wait until it is hot. More time and temper lost! This is one of the unnecessary cares many women are forced to endure.

On the other hand, observe the instantaneous electric water heater here pictured, which measures twelve inches in length and is attacht to any cold water pipe. The heater consists of a resistance wire extending thru a series of holes or passages in a cylindrical body of porcelain contained in a metal casing.

Instantaneous Hot Water Is Available with This New Electric Water Heater which Can Be Attacht to Any Cold Water Pipe.

The water circulates thru the same passage that contains the resistance wire and is drawn off as needed by opening the faucet. The turning of the handle of the faucet by the user, automatically actuates a double-pole snap switch for turning the electric circuit *on* or *off*. The temperature of the water can be regulated by the quantity of flow from the faucet at any temperature up to 212° Fahrenheit.

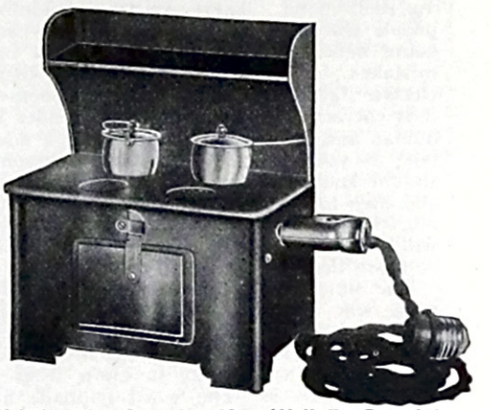
It is claimed that this machine has withstood the most severe tests, producing a continuous efficiency of 98%. Chemical analysis of water heated by this machine has shown a total absence of electrolysis. It is a great boon for shaving, medicinal uses, etc., particularly in the latter case, as most people have a fear of being poisoned by scale or other foreign matter, sediment, et cetera, which may accumulate in the ordinary boiler or water heater in which the water has a chance to corrode the metal. The present device heats fresh, cold water right from the supply pipe.

NEW ELECTRIC HAND MIRROR.

The electric hand mirror is the newest vanity wrinkle of the boudoir. The mirror contains a battery and a small electric bulb to throw the light on the face of the user.

ELECTRIC TOYS THAT REALLY WORK.

While the miniature instrument here shown is a *toy telephone*, and while the price is so low that it is in great demand as a toy for boys and girls, it is so well made and operates so satisfactorily that it is really well fitted for practical use. The receiver and transmitter are of the simplest possible construction and yet are thoroly efficient. This telephone is equipt with push button and calling device for signaling and the circuit requires only two wires for both ringing and talking. It can be used to communicate from one room to the other in a house, or from house to house over moderate distances or from house to barn or garage. The cabinet and all parts are nicely finished in a manner which will be acceptable in any home. This desk set is almost a replica of the regular standard desk telephone. It is said to be the only real toy desk stand on the market that operates electrically, just the same as any other telephone. In these toy telephones a very efficient little watch-case receiver and sensitive gold electrode transmitter are used, so that the transmission is perfect.



Little Miss America May Well Be Proud to Possess One of These Miniature Electric Ranges which Cook Just Like Mother's. They Operate from Any Lamp Socket.

The other electric toy novelty shown is an electric toy stove furnished complete with cord, plug, detachable connector, and with two cooking utensils. It weighs 2 pounds, 7 ounces, and is a practical cooking device. It provides hours of fun and pleasure to the juvenile mothers of the land who are so fortunate as to possess one and the price is within reach of most everyone.

The trend of all modern toys is toward practicability. Will it prove instructive as well as entertaining is the all-important question. The miniature electric range here shown will please every little girl that owns one, for with it she can actually cook and no matches enter the game.

A Toy Telephone that Works to Perfection.

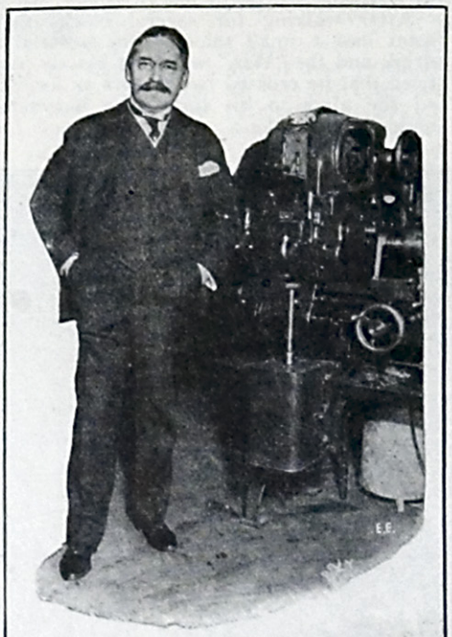
CORRECTION.

I beg to call your attention to a slight mistake in the January issue, regarding the installation of Radio stations by the Montana Power Company.

The station referred to as Spring Creek is located near Lewistown, Montana, and was installed as a private station by Mr. A. C. Campbell. The other station referred to as the Rainbow Hotel station is located at the Rainbow Power Plant, near Great Falls, Montana, and was installed by myself.—C. H. WATSON, R.E.

PROF. PUPIN MAKES VALUABLE RADIO INVENTION.

Prof. Michael I. Pupin of Columbia University has just devised and announced his perfection of a method for eliminating static interference with wireless transmission. This interference has been the great draw-



Prof. Michael I. Pupin, Columbia University Savant, Who Announces a Startling Discovery in the Elimination of Radio Interference.

back to wireless telegraphy since that means of communication was invented.

The new invention, if it accomplishes perfectly its object, will be listed as one of the most important electro-physical discoveries ever made. Under present conditions it is often impossible to get wireless messages thru for days because of atmospheric and other physical interferences, and at all times of the year during portions of the day transmission is impossible. Prof. Pupin's invention, however, is intended to make it possible to use the wireless for twenty-four hours a day every day in the year. The importance of the invention in time of war is incalculable.

The inventor has announced that he has placed at the disposal of the War Department his new method of eliminating static interference with the transmission of messages by wireless telegraphy. One of his most famous inventions is the *Pupin loading coil system*, for telephone lines, which has made possible greatly extended distances over which telephone communication can be held. In fact it practically doubled the ordinary range attainable without loading coils.

ELLIOTT CRESSON MEDAL AWARDED E. F. NORTHRUP FOR ELECTRIC FURNACE RESEARCH.

The Franklin Institute has recently awarded its Elliott Cresson gold medal to Edwin Fitch Northrup, research physicist, of Princeton, N.J.

This award was made in recognition of a special type of electric furnace developed by Dr. Northrup, in which a temperature of more than 3,000 degrees centigrade can be developed, and of his pyrometric methods and new pyrometric apparatus for the direct and accurate reading of high temperatures up to 1,600 or 1,700 degrees centigrade. Means are provided whereby, with a slight modification in the pyrometric apparatus, rapid measurements can be made of the resistivities of many molten metals and other liquid materials through a wide range of temperature.

DAY SET FOR FINAL HEARING OF TUCKERTON RADIO SUIT

Vice-Chancellor Stevens, at Trenton, N.J., has fixt September twelfth as the date for final hearing in the suit brought by the Compagnie Universelle de Telegraphie et de Telephonie sans fil to compel specific performance of a contract for the conveyance to it of the radio station at Tuckerton built by the Hoch-Frequenz Aktiengesellschaft fur Drahtlose Telegraphie. The French company had asked for the prompt disposition of the matter in issue on the pleadings as filed by the respective parties to the suit.

The German company had opposed a disposition of the case on the filed pleadings, urging that it should have the opportunity to take testimony in Germany relating to the amount expended on the two stations and other matters bearing upon the litigation. Vice-Chancellor Stevens took this view, but added that the taking of testimony should not be permitted to stay indefinitely the proceedings. Six months would be a reasonable time to give the company he says in the order fixing the date.

The court also held that the option taken by the French company is in such form that, even tho it may be impossible because of the war, to acquire possession of the corresponding station in Germany at this time, this would not prevent enforcement of so much of the contract as pertains to the Tuckerton station.

A NEW DISCOVERY.

The New York *Evening World* is admittedly a great paper. It does quite a good deal for education in general and is as instructive as it is entertaining. Just now it is running a special feature for children: "Dicky and Dot in the Wonder City," conducted by Eleanor Schorer. The series is a good one and instructive as well, and the kiddies sure do like it.

But might we suggest to Miss Schorer that she become a regular reader of THE ELECTRICAL EXPERIMENTER? It would help her to conduct the series technically correct, which we are sad to see, is not being done now. Several glaring mistakes have appeared so far and we reproduce the latest herewith, simply to show how bad a little knowledge sometimes is:

The illustration with caption taken from the *Evening World* of February twenty-second tells the story better than words. It gives children as well as grownups a totally wrong idea of the X-ray. For as our readers know well, X-rays are invisible to the human eye. In order to see the bones of the hand it is quite necessary to interpose a platinum-barium-cyanide screen, or other fluorescent screen, between the eye

DICKY AND DOT SAW RIGHT THROUGH THEIR HANDS.

How a New York Daily Paper Imagines the X-Ray to Work—Place Your Hand Against the X-Ray Bulb and Presto! You See the Bones. But—Well, Read the Above.

and the hand. Otherwise nothing is seen. The vitally necessary screen could have been shown by the artist without much trouble. As the illustration stands, it is decidedly misleading.

TELEPHONIST SAVES 1700 LIVES IN MUNITION FIRE.

One of the most courageous acts that it has been our duty to chronicle is that of Miss Tessie McNamara, who distinguished herself by sticking to her post at the gigantic munition fire which wrecked the plant of the Canadian Car and Foundry Company at Kingsland, N.J., on January 11, 1917. Shells screamed thru the air and

Ladies and Gentlemen: Meet Miss Tessie McNamara, the Telephonist Heroine, Who Stuck to Her Post and Saved 1700 Lives in the Kingsland Munition Fire.

burst all about the building in which the brave young lady kept at her duty—but let us listen to the words of Miss McNamara herself. Her interview follows:

"About 3:45, while handling the usual volume of calls, I answered drop No. 30, the cleaning room, and got the following excited message, 'Tess, call the Police Department, Fire Department and the D. L. & W. carshops—have the fire whistle blown—there is fire in this building which is getting away from us!'

"I shouted to the men in the office and they all rushed out to the fire, leaving me alone. I worked on these calls, knowing that if I didn't nobody else would, and glancing out, saw the fire spreading rapidly.

"My first thought was to save the lives of the 1,700 men in the different buildings, and I was calling them up when Mr. Bunnell, who had been one of the first to rush out to investigate, flung himself in and I established a connection for him over the tie line to the New York office. While he was talking the first shell struck the building and past about five feet from where we were sitting That gave me an awful scare. Mr. Bunnell again went out, leaving me alone, and I would have given up if I had not heard the voice of the central office operator on the line, who was passing the calls for outside help as fast as I could give them; all the while I was getting building after building in turn and spreading the alarm.

"By this time things began to hum. Shells were dropping all around and I thought every minute would be my last. About a dozen buildings were now on fire, and I had completed all calls. No more were coming in and I started for the door without coat or hat. Just then three of the boys who had mist me appeared in the office doorway. One of them shouted, 'Come on, Tess,' but I couldn't walk. My courage left me and I needed their assistance to get out. They picked me up, wrapt a big coat around me, and rusht for the gate, shells dropping all around us. It was an experience I never want to tackle again. The fire was bad enough, but the constant explosions unnerved me."

The "Wireless Wiz" and the Card Sharks

By THOMAS W. BENSON

WHILE the rest of the people along the Atlantic Coast were worrying about man-eating sharks, the "Wiz" was tackling the problem of card sharks. His success with the latter almost led him to tackle the former, but the field seemed overcrowded.

It came about in two ways. One evening he heard a visitor telling his mother how her oldest boy was gambling too much. He was throwing away all his money on games of chance and was losing consistently. She could not make him pay any attention to her and as a result worried greatly about his morals.

The real cause of the "Wiz" tackling the job was another call from Captain Duffy of Headquarters.

"You see, Jim," he said, "we know there is gambling going on. Rumors have reached us repeatedly thru various channels, but nothing definite could be learned. Now I want you to locate the place and get the goods on them. No, I think you will have to do this for glory," he finished, answering the Wizard's unasked question.

"That's all right, Cap," the Wiz laughed, "I was fully repaid for the trouble I took with those counterfeiters, so I won't ask for any reward this time."

Duffy left shortly to allow the "Wiz" to think it over. He was deep in the subject when I broke in and derailed his train of thought.

"I have one clue," he was speaking slowly as if every word was an effort, "Joe Culver is gambling a lot; by trailing him, we can locate the place, but I'd like to get in and see if the game is crooked. I have it," he continued, "I'll ask him, or rather let him, take me there."

Thought was father to the action and he called Joe on the 'phone and asked him if he could come around the following evening. The reply was satisfactory and the "Wiz" smiled to himself and yawned, the signal that meant "good night."

The next day the "Wiz" was busy getting some apparatus together. He made a coil of wire that would fit around his waist easily. He took an old glove and fastened contacts on the tips of the first and second fingers. He then took an old watch he had discarded some time previous and removed the mechanism. In its place he put a special telephone receiver he had made and run one wire to the case and the other to an insulated contact on the stem. The face and hands were left in the watch and the stem soldered so it would not move.

When Culver called that evening the "Wiz" told him what he had overheard Mrs. Culver say, and told him he was going with him to see if the game was crooked.

Joe protested at first but the "Wiz" induced him to lead on. If the game was crooked it was only right that Joe should be warned.

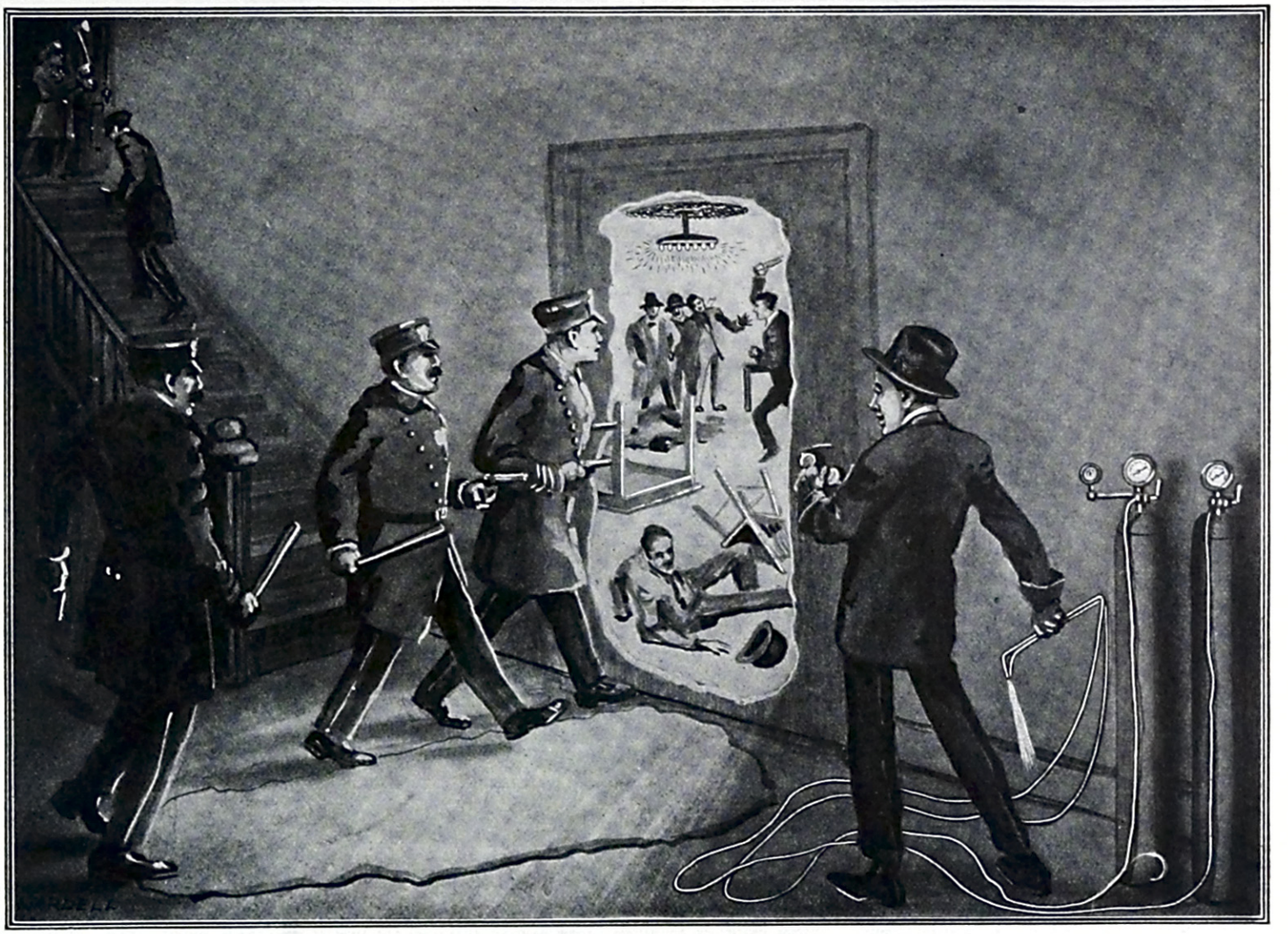
After walking for several blocks they went into a small saloon. Joe ordered a drink and the "Wiz," watching closely, noticed that he crossed two fingers as he lifted the glass to his lips. The bartender nodded and spoke a commonplace and Joe made for the back room where a man approached, shook hands, and escorted them up-stairs.

At the landing they turned to the left, where Joe gave a certain series of knocks on a door which appeared to be made of wood, yet the "Wiz" noted it was of steel, grained to give the appearance of hard wood.

They entered a large room which was completely surrounded by a solid wall. The "Wiz" surmised that it was a room built inside another and made of steel. A ladder up the further end indicated a means of escape, should necessity arise.

Scattered around the room was a number of tables at which games of the good old American game of *poker* were going on. Clusters of lights were arranged near the ceiling which illuminated the room brightly.

Joe had no trouble in getting the "Wiz" in, since he was a habitué of the place



". . . but the 'Wiz' had already turned his oxy-acetylene torch on the door and slowly but surely ate his way thru it. . . . At last the door burst open and the officers rushed into a scene so different from that which had greeted the Wizard's eyes, but a short time before. 'You are trapt,' the Captain's stentorian tones rang out."

and well known to all.

The "Wiz" glanced around and advanced to a table where quite heavy stakes were being put up and watched the game for several minutes. The players seemed to be old hands, for only the necessary words were spoken to indicate their actions, their faces being as blank as so many stone images.

The "Wiz" took out his prepared watch and glanced at it, noted it was probably wrong and put it to his ear and appeared to listen. Taking it between his fingers he gave it a rotary motion as if to start it and replaced to his ear, when he heard the buzz of a wireless signal. His face indicated nothing unusual, but he swore softly under his breath apparently at the watch, but more likely at the contemptible cheater at the table.

Next the "Wiz" began to examine the room carefully from the corner of his eye to determine how the signaling was accomplisht. An almost imperceptible flash from the filigree work around the base of one of the lighting units attracted his attention and gave him the clue.

Somebody was up there looking thru the open work with a pair of opera glasses, reading the cards and signaling them to a man at the table.

Meanwhile, Joe had sat in at one of the tables and was losing regularly. His available cash was low, so he arose shortly with an oath.

The "Wiz" called him aside and whispered that the game was crooked and outlined the method they used. This drove Joe into an uncontrollable rage and pulling a gun he let drive at one of the filigreed lamp bases. Joe then sprang on a table and shouted—"The game is crooked, they have spies behind that open work looking at the cards," then springing down he overturned a table, but nothing was apparent as to how the signals reached the man at the table.

As a roar of anger arose from the players, the lights were switched out. The "Wiz" seized Joe and pulled him to the ladder leading thru the ceiling and they ran up into a low chamber. Using his flashlight the "Wiz" saw several men moving around and flashing his "gat," he covered them. "Which way out, quick?" he ordered and one pointed to a trap door. Pushing this up they found themselves on the roof of the building.

They raced along the row of houses trying the trap-doors in the roofs till one yielded. Diving down, they ran thru the house to the front door. A man tried to stop them, but a glimpse of the gun was enough. He agreed they had a perfect right to be there.

Rushing into the street the "Wiz" had recourse to his whistle and two officers answered his signal. "Let no one escape from that building," he ordered, "while I 'phone for reserves," running to a store across the street and getting the night sergeant on the wire.

Time was precious and the reserves knew it, as they came clanging up in their high-powered car. It takes longer to describe these things than it does for them to happen. While the gamblers fought in the steel room, the "Wiz" placed men to guard every entrance as well as the roof.

"Hold them," he ordered, "till I return. That door is of steel and we can't get in, but I will." He sprang into the auto that had brought the reserves and ordered the driver to take him home. Rushing into his "lab" he picked up two metal cylinders, a pair of goggles and a peculiar looking tool to which was connected two rubber pipes.

Returning to the car he attached the rubber pipes to the cylinders as they sped back, and as he jumped down he looked a strange sight indeed. The tubes under one arm, while a hissing white flame gushed from the tool in his hand and a pair of goggles covered his eyes.

The captain led a detail of men into the saloon, which was deserted in the excitement, up the steps and pounded on the steel door with the butt of his service revolver, ordering it to be opened in the name of the law.

No reply came from beyond the panels but at that moment the sound of distant shots rang out. "They are escaping to the roof," roared the cop. "For God's sake do something." But the "Wiz" had already turned his oxy-acetylene torch on the door and was slowly but surely biting his way thru it.

The shots rang out again but the "Wiz" was intent on that thin knife of flame, which was cutting its sputtering way up the length of the door.

It seemed ages before he was half way thru and another century must have past before it reached the upper edge.

At last the door burst open and the officers rushed into a scene so different from that which had greeted the Wizard's eyes, but a short while before.

At the far end of the room the gamblers

(*Continued on page 911*)

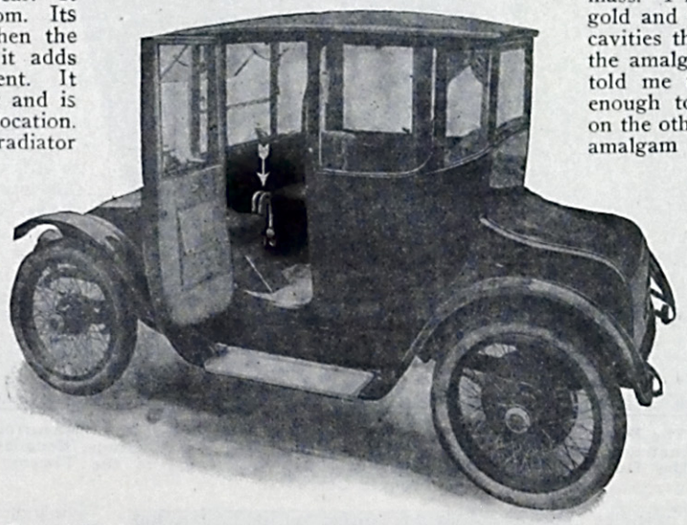
ELECTRIC RADIATOR FOR AUTOS.

The electric radiator here shown installed in an automobile is connected directly to the storage battery of the electric car. It is inconspicuous and takes little room. Its use of current is nominal and when the car is charged on monthly rates it adds nothing to the expense for current. It can be installed in any electric car and is placed securely in any convenient location.

The unique and highly efficient radiator looks like a small steam radiator. You have only to turn a switch and the radiator will quickly bring the car to a comfortable temperature. The radiator is not in the way and is rather an ornament than otherwise.

Changes have been made in the type of fittings used so that the heavy external cast-iron parts are now replaced by prest steel. This change increases the sensibility of the radiator, giving quicker response to the application of energy, permits a 20 per cent reduction in the net weight and gives a higher temperature rise per watt of energy expended.

The essential feature of the construction of the radiator lies in the fact that the heating element is placed in the hollow base of the radiator and is immersed in a non-oxidizing fluid with which the interior of the radiator is almost fill d. When the radiator is connected to an electric circuit of proper voltage the heating element gets very hot. This heat passes into the surrounding fluid, which as it gets hot, rises towards the top of the radiator and thus a circulation is maintained and the fluid in the radiator constantly circulates up from the heating element and then down on the side of the radiator section, back to the element, then up again, etc. These electric radiators are available in sizes of 500, 750 and 1,000 watts capacity and can be furnished for any voltage, alternating or direct current.



Something New in the Automobile World—a Small but Highly Efficient Electric Radiator, Which Can Be Connected to the Battery of Electric Vehicles.

WILL ELECTROLYSIS DESTROY TEETH?

Is there any basis for the assertion that when a person has several tooth cavities filled with different metals, say some with *amalgam* and others with gold, there is likely to be rapid decay of the teeth due to the electrolytic action between these different metals? I have heard this statement made positively by some dentists and flatly denied by others, says a querist in *Electrical Review*, to which the answer is given:

Such action depends entirely on how the *amalgam* is made. If the mixture is thoro, there is no reason for it to disintegrate. Where electrolysis has occurred it may be safely said that the mercury in the amalgam was not properly incorporated in the mass. I have one tooth that is filled with gold and with amalgam; so close were the cavities that the two metals touch. Before the amalgam filling was placed, the dentist told me that the tooth was not strong enough to warrant filling with gold, but, on the other hand, he was afraid to fill with amalgam on account of electrolysis. To discover, if possible, and to prevent electrolytic action we experimented with voltaic piles made of gold and amalgam with blotters wet with sodium chloride and later with acetic acid. There was not a measurable electromotive force where the amalgam had been properly made.

Where the amalgam is not made properly, further chemical action, not electrolysis, causes the disintegration of the tooth filling. Even a poorly made amalgam filling will last four to six months, if the tooth does not decay around it. Cleaning the mouth thoroly once a day will keep the teeth clean enough to prevent decay. In the so-called electrolysis cases the cause is generally decay around the filling or chemical action in the filling which latter would occur, regardless of whether the gold was adjacent or not.

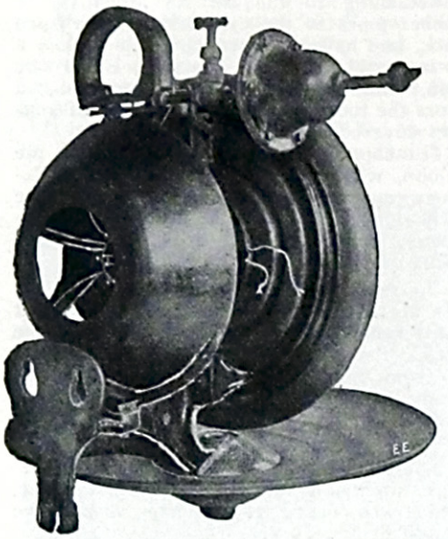
SHORTAGE RADIO OPERATORS.

Recently a Norwegian boat bound from Philadelphia to an English port wanted an operator badly. The position was offered to two Philadelphian operators, but they hesitated at taking chances with German submarines or howling gales, and the master of the craft was forced to pick up a gallant soul from New York.

AN ELECTRIC MOTOR-DRIVEN HUMIDIFIER.

By Frank C. Perkins.

The illustration herewith is that of an electrically operated and automatically controlled humidifier, developed at Charlotte, N.C. It is pointed out that in such establishments as bakeries, feather factories and tobacco houses, where a certain degree of moisture in the atmosphere is an absolute necessity for the proper preservation of certain materials the use of a moisture-producing device or humidifier is highly essential.



New Electric, Motor-driven Humidifier which Automatically Moistens the Air Whenever It Becomes Necessary.

This device is electrically operated, automatically controlled and entirely self-contained. The humidifier is mounted on the wall or columns of a room or suspended from the ceiling and the control apparatus is provided with a deflector which is in the regulator chamber, and when atmospheric conditions so require the deflector deflects the entering water into an overflow.

It may be stated that the water enters from above and passes into the regulator chamber, whence it flows directly (when the automatic control permits) to the center of a rapidly revolving disk, from which it is thrown by centrifugal force against the teeth of a copper grid at the circumference of the disk, where it is broken up. Back of the disk is a fan which forces outward all particles of moisture which are sufficiently fine to float around the edge of the case. The speed of the disk is such as to put a heavy pressure on a very thin film of water, and this film strikes the teeth of the grid with sufficient force, it is claimed, to break up the water completely into very minute particles.

The revolving disk is 16 inches in diameter and the horizontal drip pan 24 inches. Any number of *heads* may be installed. In one large textile plant, for instance, 422 heads are in successful operation, humidifying approximately 8,000,000 cubic feet of air space. Humidifiers of the type shown are particularly in demand in cotton, woollen, silk and flax mills. They are also being utilized in considerable quantities not only in this country but also in Canada, Mexico and Cuba in tobacco-leaf and tobacco manufacturing houses.

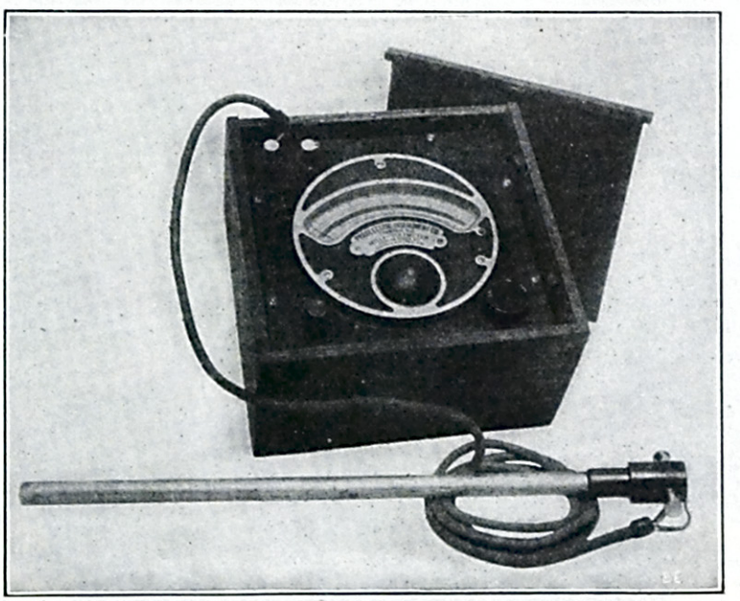
It is of interest to note that these electrical devices are especially useful in the sponge and dough rooms of bakeries, since they automatically maintain the proper humidity desired, thereby preventing the crusting of dough and causing the dough to rise uniformly and produce more loaves to each barrel of flour. By the use of cold water the temperature of a dough room may be reduced 10 degrees or more. Lately also the machines have been employed for humidifying and deodorizing theaters.

It is claimed that in mines they can be used to prevent explosions of dust. In furniture and automobile factories, the machines are utilized in fuming and varnish rooms and in printing establishments to prevent the curling of paper caused by dryness and also to prevent sticking caused by static electricity.

AN ACCURATE ELECTRIC TEMPERATURE INDICATOR.

The new electric temperature measuring instrument here illustrated is called the Pyrovolter. It combines the characteristics of the voltmeter, with the accuracy of the potentiometer, and was designed for the specific purpose of making the readings of temperature independent of the resistance of the thermocouple circuit, which resistance is apt to vary on account of corrosion, temperature conditions, etc.

The pyrovolter, as such, is not the complete measuring outfit but it is the indicator which enables one to read the voltage developed by a thermocouple of any type whatever, whether made of base metals giving a high electromotive force, or of noble metals giving a small electromotive force. The deflection instrument employed is exactly the same for all types of thermocouples and for all temperature-ranges and consist of a millivoltmeter having a strong spring control.



The Pyrovolter—the Latest in Electrical High Temperature Measuring Instruments and Said to Give Extremely Accurate Readings, Because the Deflections Are Due to Battery Current, Not to the Thermocouple Currents.

The additional feature, which permit the electromotive force of a thermocouple to be read independently of the resistance of the thermocouple circuit, consists of a switch operated by a push button, a rheostat and a battery. These parts, all being small, are located inside the wooden case in which the instrument is mounted. The push button and the handle of the rheostat are outside the case and occupy two front corners. The two ends of the thermocouple are attached to two miniature dry cells, a small rheostat and a binding post located in another corner of the case as shown.

The dry cells supply the energy which deflects the instrument, the thermocouple itself not being called upon to furnish any current for the deflection. The rheostat, operated by the handle outside the case, will move the pointe over the scale (calibrated to read in degrees Centigrade or Fahrenheit) of the instrument when the handle is turned. By turning the handle until the pointer stands at the beginning of the scale of the instrument and then pushing the button in the left front corner of the instrument the pointer at once deflects to a point on the scale which indicates the true temperature of the fire end of the thermocouple.

As the indications of the pyrovolter do not depend upon the resistance of the thermocouple circuit, it is not necessary to make the thermocouple wires heavy and of large cross-section, as is commonly done for the purpose of keeping the resistance of the thermocouple very low. Thus wires of small diameter may be used and it is entirely practicable to make the thermocouple wires long enough to reach from the fire end to the pyrovolter.

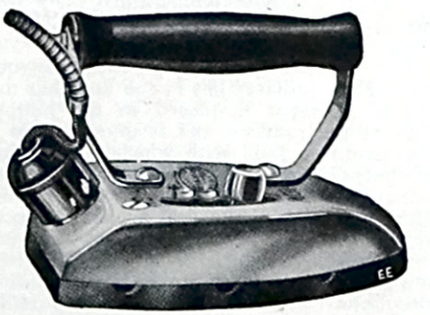
A "Thermos" bottle is supplied with the instrument for maintaining the cold junctions in ice water at 0°C. High temperatures of 1,200° to 1,500° C., are covered by this precision instrument. In the pyrovolter the battery supplies the current for the deflection, not the thermocouple.

AN ELECTRIC REGULATOR IRON THAT SAVES CURRENT.

The Regulator Sad Iron here pictured is made in such a manner that the heat can be accurately controlled while in use, its makers aver, and moreover maintained at any required degree of temperature. Four different heats (five in the larger irons) are controlled by the finger tips of the operator by the simple movement of the Regulator lever on the iron, generating a heat siutable to the daintiest fabrics up to a very high heat necessary for the heaviest damp material.

The ability to regulate the current to produce just the heat desired obviates the danger of scorching, and permits of continuous work at the proper heat for any material.

A saving of 40 per cent in current is effected due to the construction of the heating element.



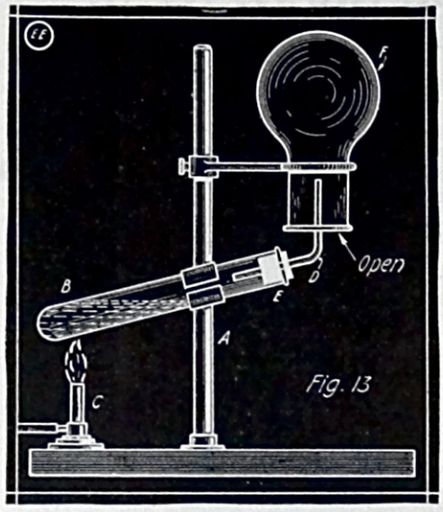
The Electric Regulator Iron That Uses Small Power for Light Ironing or Large Power for Heavy Pieces.

Experimental Physics

By JOHN J. FURIA, A. B., M. A.
Instructor in Physics and Science Master, Riverdale Country School

LESSON THREE.
GASES AND THE ATMOSPHERE.

IN the last lesson we noted that air is a material substance and differs from simple space. It can be weighed and carried about from place to place. It can be comprest and expanded and when comprest exerts a force. We also



Preparing the Ammonia Gas for the "Ammonia Fountain" by Heating a Mixture of Sal-Ammoniac and Slaked Lime.

found that it was this force of comprest air (or of other gas) that makes possible all sorts of explosions, both destructive and beneficial. In this lesson we are to study the air and to see how it differs from space and how it resembles other gases. At this stage it is necessary that we know exactly what is meant by a gas and that we understand the *Molecular Theory* and the *Kinetic Theory* of gases. Matter is generally defined as anything that occupies space. The different kinds of matter are called substances. Substances differ in the way in which they occupy space, and it is this difference that determines their physical state. The three physical states of matter are the *solid*, the *liquid*, and the *gaseous*. A solid has a definite shape or form, and therefore a definite volume. A liquid has no definite form, but has however a definite volume. It can fill a vessel only to the extent of its volume and takes the shape of the containing vessel in so far as it fills it. *Gases have neither definite form nor definite volume.* They tend to distribute themselves in all directions and fill completely any vessel into which they are placed; their only boundaries are the containing walls.

EXPERIMENT 11—

Heat a piece of ice. The ice melts into water. If now the water is heated to the boiling temperature (212° Fahrenheit) it changes into steam. By this very simple experiment we have shown that a solid can be changed into a liquid, and then the liquid into a gas. We must not, however, infer that in order to change a solid into a gas it must first be changed into a liquid. If a few Iodine crystals be heated we notice that they pass immediately from the solid state to the gaseous state. This whole process is reversible, *i.e.*, we can begin with the gas and change it to the liquid and solid state. For example, steam can be condensed into water and then the water can be frozen into ice. This change of state is utilized practically in many ways.

EXPERIMENT 12—

Purifying a liquid by distillation. The apparatus (Figure 12) can be bought made of glass, or can be easily constructed as follows: G and H are two lamp chimneys of identical size, connected together by a straight rubber stopper B which contains three holes. DEF is a piece of glass tubing passing thru the center holes of the rubber stoppers A, B, and C. (The tubing is easily bent into the shape shown in the diagram by the use of a wing top Bunsen flame, as explained in the first and second lessons of *Experimental Chemistry* of the series now appearing in THE ELECTRICAL EXPERIMENTER.) R and S are also pieces

IN THE MAY "E.E."

The May issue will be a wonderful "Edison number," including a remarkable interview with the famous inventor and some exceptional photographs of him, including a handsome cover painting in colors.

Baron Münchhausen's New Scientific Adventures—By Hugo Gernsback.

The Sources of Electricity—special feature article illustrating and explaining in popular style, all of the principal known sources of this form of energy.

Electricity's Aid to the Fair Sex—A page of live interest to all women, showing in snappy illustrations how the magic power of electricity has been tamed to iron the clothes, boil the coffee, cook the roast and a host of other things.

The "Strong" High Frequency Coil and How It Works—By Dr. Frederick Finch Strong.

The Washington's Birthday Radio Relay—Results and Prize Awards—By W. H. Kirwan, 9XE.

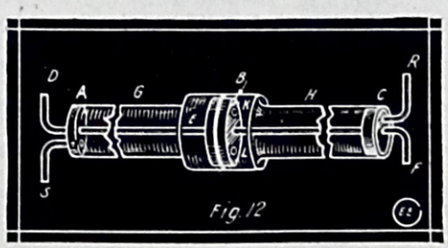
The Calculation and Measurement of Inductance—Part III of this series by H. Winfield Secor and Samuel Cohen.

Experimental Physics—Fourth paper of the new series—By John J. Furia, A.B., M.A., F.K.S.

Several interesting articles in "The Constructor" Department, including details of an illuminated sulky and harness outfit adapted to parade and stage requirements. It operates on dry cells and was actually built.

Watch the Radio Department!

of glass tubing; K and L are holes in the stopper B, which must be left open. Steam is allowed to enter D, while R is connected to the water faucet. The steam in passing from D to F is condensed into water be-

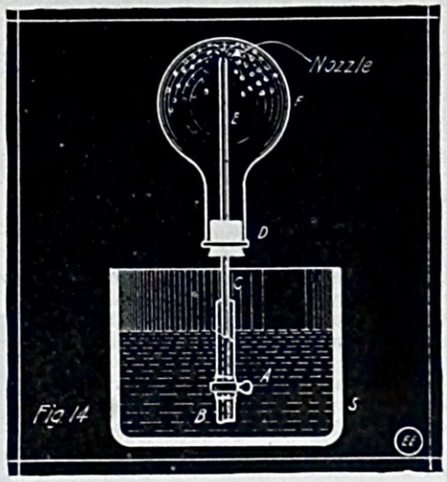


Simple Condenser Made from Two Lamp Chimneys, Some Glass Tubing and Three Rubber Corks for Demonstrating the Process of Distillation.

cause of the cold water which is passing around the tube DEF and out thru S.

EXPERIMENT 13—

Allow a piece of washing soda to stand in a dry place uncovered for a few hours. We notice that the crystal changes into a powder and if we weigh carefully the crystal before allowing it to stand and after, we find that it loses weight. The loss in weight is explained by the fact that the crystal contained water and the water evaporated into the atmosphere. This shows that a *solid*



The "Ammonia Fountain"—An Extremely Interesting Apparatus Readily Constructed by the Student. Ammonia Gas Causes the Water to Rush Out Thru the Nozzle As Shown.

may very readily contain a *liquid* in it.

EXPERIMENT 14—

Allow a glass of water to stand over night uncovered. In the morning we find that there are many bubbles clinging to the sides of the vessel containing the water. These are bubbles of air. That is we have shown that a *liquid* may contain a *gas* dissolved in it. If it were not for this fact, fish could not exist, because of their need of air or at least of the essential constituent of the air, Oxygen.

EXPERIMENT 15—

Fill four tumblers with water. In the first, place a pebble; in the second, a lump of sugar; in the third, a tablespoonful of red ink and in the fourth a tablespoonful of some oil that is not colorless. After stirring the four we find that the pebble remains as it was, that the sugar disappears (dissolves), the red ink mixes with the water so that the whole tumblerful is red, but the oil remains separated from the water. We conclude that *some solids* dissolve in a *liquid* while others do not.

EXPERIMENT 16—

The ammonia fountain showing the dissolving of a gas in liquid. Part one—The preparation of ammonia gas (see figure 13). Ammonia gas is lighter than water and hence can be collected by the upward displacement of air. Mix about a teaspoonful of ammonium chlorid (sal-ammoniac) with an equal quantity of calcium hydroxid (slaked lime) and place in test tube B. F is a Florence flask, or a beer bottle, or some other glass bottle. D is a piece of glass tubing thru rubber stopper E. C is an ordinary Bunsen flame, and A a ring stand or some other contrivance for holding the test tube and flask in the positions shown in the diagram. As a result of the chemical action in the test tube, ammonia is given off and passes into the flask displacing the air.

EXPERIMENT 17—

The ammonia fountain. Part two—(see figure 14). Holding the flask F in the same

(*Continued on page 941*)

The RADIO LEAGUE of AMERICA

HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.

H. Gernsback, Manager W. H. Kirwan, Master of Radio Relays

The Washington's Birthday Relay and the Q. R. M. League of America

By W. H. KIRWAN, (9XE)
Master Radio Relays, Radio League of America

ALL of you have probably read in this magazine about the Washington's Birthday Relay. The amount of work in connection with one of these Relays is practically unknown to most of you, but the results of them are most gratifying as it interests new talent thruout the country and, moreover, tends to bring to the public notice the real worth of the wireless amateurs in the United States.

A certain magazine in the East, which surely cannot have the real interests of the amateurs at heart claims that there is a danger signal up and that if you did not join its crowd, all of our licenses would be taken away. When things get so bad in the wireless world that a few struggling nonentities can convince intelligent Americans that there is any danger of our licenses being taken away from us, then we all should lose them, as we will not have enough spunk to operate anything.

There is no danger signal up and there is plenty of room in this country for more than just one select crowd of "air hogs," who are nothing more or less than a specimen of the "end seat hog," and we know enough about them to know that most of them are vacuums and need not cause us any worry outside of an extra effort occasionally to push them out of the way. We are organizing a *Q. R. M. League of the United States* and every state will have a captain, three lieutenants, nine sergeants and a number of willing helpers to act as privates. Now, let's get together and form a real army of workers and see if we cannot, by getting the opinion from all the different states, agree upon a working basis for all stations with justice to all. This we know is necessary and you need have no fear of the calamity howlers who claim that the minute you look cross-eyed you are going to lose your license. Use your head and put these pests on the shelf, where they really belong. Watch this magazine closely, as all of the states, as soon as organized, will have the names of their various representatives printed in this magazine, and we have the support of some of the best thinkers in the country to help us.

This magazine has done more for the amateurs than all the rest put together, as it originally championed our cause and has been working incessantly ever since. It has championed the Q. R. M. League and we know that it will put this across the plate with the same determined effort as marked its other activities in our behalf.

The slogan is "JOIN THE Q. R. M. LEAGUE NOW." A great many of the states are already organized, and we have some very willing workers in every portion of the country.

The Washington's Birthday Relay was handled by men and their stations who are cooperating in the formation of this League and you can readily see from the names publisht in this magazine that you will be honored in joining with some of the most progressive amateurs in the country. There is lots of work being done, of which we hear little, and our brothers on the Pacific Coast are having the time of their lives with Q. R. M.*, but, thru it all, have done some remarkable work.

ANNUAL TROPHY
DONATED BY 9XE
and awarded each year to the best equipped and most efficient amateur wireless station in the United States.
Awarded in 1917 to
1918 to
E.E.

We present herewith a photograph of a large silver trophy which will be given to the best Radio Amateur Station. It stands 21" high and 13" across, and will be suitably engraved.

It is to be presented to the best equipt and most efficient amateur station in the United States, after the end of the working season. A committee will be appointed from the various clubs thruout the country, to decide who is entitled to it and to hold it until next year, when soemone else may be awarded it. Holding it two years in succession will mean that it belongs to the station holding it. This is Mr. Kirwan's timely idea to have the amateurs perfect their outfits and numerous points will be taken into consideration when awarding it, as those amateurs who continually "QRM" will not be considered.

Mr. Kirwan has gone to some little expense in this matter and trusts that he will have the cooperation of all loyal Radio-bugs. The awarding of this prize will undoubtedly cause considerable interest in Bugdom.

Now, just for a little gossip of the stations around 'Frisco and from whom the writer heard too late to publish in the last story to this magazine. Gilbert of Pomona, Cal., and our friend, Winser of Bakersfield, have installed a large power station 100 miles from home, but were on the job for the relay. Bunting of Centerville burned out his transformer and had as substitutes in the relay—6FT and 6BY. He participated in breaking QRM however.

Word has been received from Emerson, 5 DU, in Dallas, Texas, that he has worked Higgy of Phoenix, Ariz., 6 DM, and both are making tests early every Friday morning. L. S. Hoyt, 6 SI, of Hayward, Cal., reports hearing 5 DU regularly. Turner, 6 ABR, of Los Angeles, states he has actually worked with 9 ZF in Denver, Colo. This is in keeping with the best work that has been done in the Central or Eastern parts of the United States. It is too bad we did not hear from these stations before lining up the schedule.

We call all of your attention to 6 DM, of Phoenix, who works regularly 6 BY, 6 FT, 6 WZ, who are in the neighborhood of 700 miles from him. 6 AAG, 6 SR, 6 EA, 6 RG, and 6 ABR are about 350 miles and, of course, 6 DM has no trouble in working them.

The following stations are practically close and have no trouble whatever in working thru Q. R. M. at any time. 6 EA, 6 ABR, 6 AAG, 6 ZW, 6 NL, 6 AY and 6 RG are close enough to work each other at all times, but have no trouble in working any of the following stations, which are at least 200 miles from them, as follows:

6 BY, 6 HO, 6 TR, 6 SI, 6 IB, 6 AU, 6 SH, 6 SX, 6 AHN, 6 WZ, 6 BJ, 6 FT, 6 AGW and JS.

This Western coast is surely the country of magnificent distances.

Another part of the United States that few of you are acquainted with is Colorado, which has one of the largest and best equipt radio stations in the Colorado Wireless Association at the Y.M.C.A. Building in Denver. Mr. W. H. Smith, the chief operator, received the first commercial

(Continued on page 942)

**For the benefit of our lay readers: Q. R. M. is the abbreviation term accepted by the International Radiotelegraphic Convention for interference. If one operator asks Q. R. M.? of another it means "Are you interfered with?"*

Editor's Mail Bag

Under this heading are publisht communications from our readers of general interest to all concerned. In order that letters shall receive proper attention, we earnestly request you to make them as short and concise as possible. This is essential on account of the great amount of mail received daily.

No attention can be paid to unsigned communications, but on request we will withhold the correspondent's name.

EDITOR.

"E.E." TO THE FRONT.

Editor Electrical Experimenter:

Mr. Kelly, a locomotive engineer of this locality, was in our office to-day and spoke of some articles that were publisht in your last issue. He also said that your paper was coming to the front and that he believed would soon take the lead of all technical magazines. Thought this might interest you and that is why we have mentioned this instance. Thanking you very much for past courtesies, we remain,

THE ELEC. ACCUMULATOR CO., INC.
Per FREDERICK W. REEVES, Pres.
Pittsburgh, Pa.

[*Comment such as this, coming from an expert source, cannot but spur us on towards making this journal the greatest of its kind.—Editor.*]

THE BRITISH LION ROARS!

Editor The Electrical Experimenter:

As a new reader of THE ELECTRICAL EXPERIMENTER I am writing to tell you what I think of your paper.

Comparing it with other papers in England, of the same class, I consider it the best paper I have come across. In fact, so far it has proved just the sort of paper that I wanted on that subject (electricity).

I am not filling in your voting blank, as your articles are all to my liking. The only two things that I do not like are not down on the voting blank.

They are the size of the journal, which I think is too long as well as a little too wide. The reason I think so is because it is much more convenient to put a paper which is smaller and which could be thicker in your pocket, than one which is large. You may wonder what I want to put it in my pocket for; well it is, so that I may read it on my way to work in the train in the morning, or any other time so that this time may not be wasted. The second objection is that of having to turn to the end of the book for the other part of the article. I would much sooner that the articles continued straight thru the paper and not at the end. I am sending the money to have THE ELECTRICAL EXPERIMENTER sent to me thru your agent at Liverpool.

Wish you success and hope you will have many new English readers for your paper.

GEOFFREY WIDDOWSON.
Carlton, Nottingham, England.

[*Every once in a while we have criticisms of this kind, so we will explain. Where would our many, beautiful, large wash drawings and illustrations be if the pages were smaller? Also, smaller magazines do not lay "flat" when opened up, and the hand tires while holding such magazines. As to the articles continuing in the back among the "ads" this is done so that the reader cannot fail to see the "ads." Always remember that the magazine could not exist for two months if it were not for the advertisements. The advertiser paying at the rate of $128.00 for a page deserves some consideration. It is the practise of the largest and best publications, and the readers lose nothing by submitting themselves to a little inconvenience.—Editor.*]

AS TO LATE DELIVERY.

Editor The Electrical Experimenter:

One day, while visiting a friend of mine, he gave me an ELECTRICAL EXPERIMENTER, issue of November, 1916, and ever since I have become a "bug" on wireless and am making my own apparatus as fast as I can. I am an old time railroad operator and know something about telegraphy. I am an enthusiastic reader of the EXPERIMENTER and I would rather miss my meals than miss it, but why is it we get it so late here in Pittsburgh, when it is issued, as you say, the fifteenth of every month. We sometimes don't get it for a week or ten days after the fifteenth.

I enjoy reading every page of it and the information one can get out of it is worth ten times the price per issue. Wishing you the success you deserve, I am

M. H. BREX.

N.S. Pittsburgh, Pa.

[*We are receiving a great many complaints as to late delivery lately, especially from our many newsstand readers. Unfortunately we cannot remedy this now on account of the existing country-wide train blockade. All freight moves exceedingly slow nowadays, and this condition will probably prevail until the end of the war.—Editor.*]

AN INDEX FOR "E.E."

Editor The Electrical Experimenter:

I am writing this letter in the form of a suggestion. It seems to me that there is great need for an index and cross record for all the articles appearing in your magazine. As it is now, it takes hours to find an article that one has seen publisht, while, if a monthly index were publisht, and this bound together at the end of the year, a very good reference work for the amateur could be made of the EXPERIMENTER. A booklet containing all the questions and answers to date would also be in great demand.

I should also like to see appear in the EXPERIMENTER more Audion hookups for undamped waves with as little apparatus as possible.

FRANK SAHLMANN.
Manhattan, Kans.

[*We have been thinking about an index for some time and we have had a great many similar requests to the above one. But as not every reader desires an index, and as it obviously would take up a good deal of space which we would rather fill with text, we decided to print a separate index in form of a small booklet. This index will cover every article publisht in the "E.E." since its first number. It will be ready April first. Price 10 cents prepaid. See our advertising section in the May issue for further particulars.*

A 25 cent book containing all "Questions and Answers" publist to date will be issued by us at an early date.—Editor.]

AN URGENT NEED.

Editor The Electrical Experimenter:

Ten years ago I timidly advocated and prayerfully urged the use of car-axle power for ventilating and lighting cars and was laughed at and scorned by the railway and other so-called experts of the time. Forgetting the down-grade waste of power, they advanced the theory that such a scheme would put just that much more work on the engine so, therefore, it had better be done direct. And they did light the cars by direct engine power.

Now, however, that axle-power has come into its own and is at last acknowledged as the best and cheapest means of lighting cars, why can't our experts go a step farther and put in a little individual ventilating plant in each sleeping car, at least, and operate it with axle-power too? A system of fans pulling air through a fine screen and blowing it over heating coils in winter and the ice tank in summer, something, anything to secure a little better air and regular temperature than we have now, when such details are left to the vagaries of a sleepy Senegambian. Especially are we interested in securing a little better ventilation of the berths, the coops in which we are almost hermetically sealed in at night.

Such is again the prayer of a fresh-air fiend, a fellow who sleeps out-of-doors at home but who has to spend many a night in the aforementioned air-tight coffin-like coops.

F. W. FITZPATRICK.
Omaha, Neb.

[*This is a capital idea, and as practical as it is excellent. Besides the expense should not be very large, especially when a new car is built. We commend the idea to our railroad officials.—Editor.*]

FROM THE RADIO CLUB OF FLINT.

Editor The Electrical Experimenter:

The series "The How and Why of Radio Apparatus" is the best one ever publisht. It is what we have been looking for for a long time to present to the beginner. We have lost many members of this Club on account of not being able to interest the fellow just starting in.

The article on the induction coil will be read at the next meeting and I hope many other similar articles will follow.

R. J. FREWLEN.
Flint, Mich.

[*We had not thot of it that some of our articles might make good lecture material, but evidently such is the case. Appreciation of this sort spurs us to greater efforts, and we assure the Radio Fraternity that we will not be found wanting.—Editor.*]

WOMEN EMPLOYES IN ELECTRICITY WORKS.

The Local Government Board has forwarded to local authorities and electric supply companies thruout the country a memorandum prepared by the Home Office and Board of Trade dealing with the substitution of women for men in municipal services, particularly in electricity undertakings, says *The Electrician*, London.

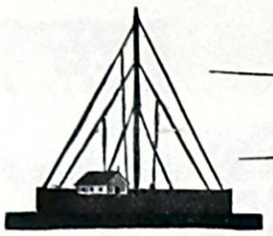
For some time past the Marylebone electrical supply has been employing women to carry out the duties, among others, of junior engine drivers, volt regulators, lamplighters, meter testers and maintenance attendants.

WHAT THEY LEARNED.

A visitor to a Sunday-school was asked to address a few remarks to the children. He took the familiar theme of the children who mocked Elisha on his journey to Bethel—how the young ones taunted the prophet, and how they were punished when two she-bears came out of the wood and ate forty-two of them.

"And now, children," said he, "what does this story show?"

"Please, sir," came from a little girl in the front row, "it shows how many children two she-bears can hold!"—*Tit-Bits.*



RADIO DEPARTMENT

Giant U. S. Radio Station at San Diego Ready

IN the presence of prominent San Diego citizens and Army and Navy officers the great Chollas Heights U.S. naval radio station was formally placed in commission on January twenty-sixth, with the exchange of greetings between Mayor E. A. Capps and Josephus Daniels, Secretary of the Navy, and William Kettner, Representative in Congress.

The Chollas Heights station under favorable conditions can flash messages 12,000 miles. In preliminary tests code messages flashed in Germany have been picked up in this station. Command of the new station will be directly under Lieutenant John Ashley, superintendent of the naval radio service for the Southern California district.

The new government wireless station gave a demonstration of its power when the operators on duty talked with the Arlington station, with Melbourne, Australia, with Panama, and with Nome, Alaska, and also Honolulu. At the same time it overheard French operators at work on the island of Papeete, in the South Pacific. Thus with one relay the government at Washington can talk with Australia and farthest Alaska. The San Diego station hopes to be able to reach Europe by means of its powerful instruments when they get properly tuned up.

Its opening marks an era in the direct communication service of the navy between the Atlantic and Pacific coasts.

The navy wireless stations at San Francisco and Puget Sound have been in service for some time, but they required such tremendous power to communicate directly with Arlington that anything like regular communication between them has been infrequent and the great volume of naval orders and communications have been sent by ordinary telegraph.

At San Diego there has been erected an enormous station that is more powerful and more modern than any other in the service. Its equipment will be so adjusted and of such power that communicating with Arlington will be a nominal service, not an extraordinary service, as is the case with San Francisco and Puget Sound. It will be the most powerful station in the world with the possible exception of the two German stations that send to Sayville and Tuckerton.

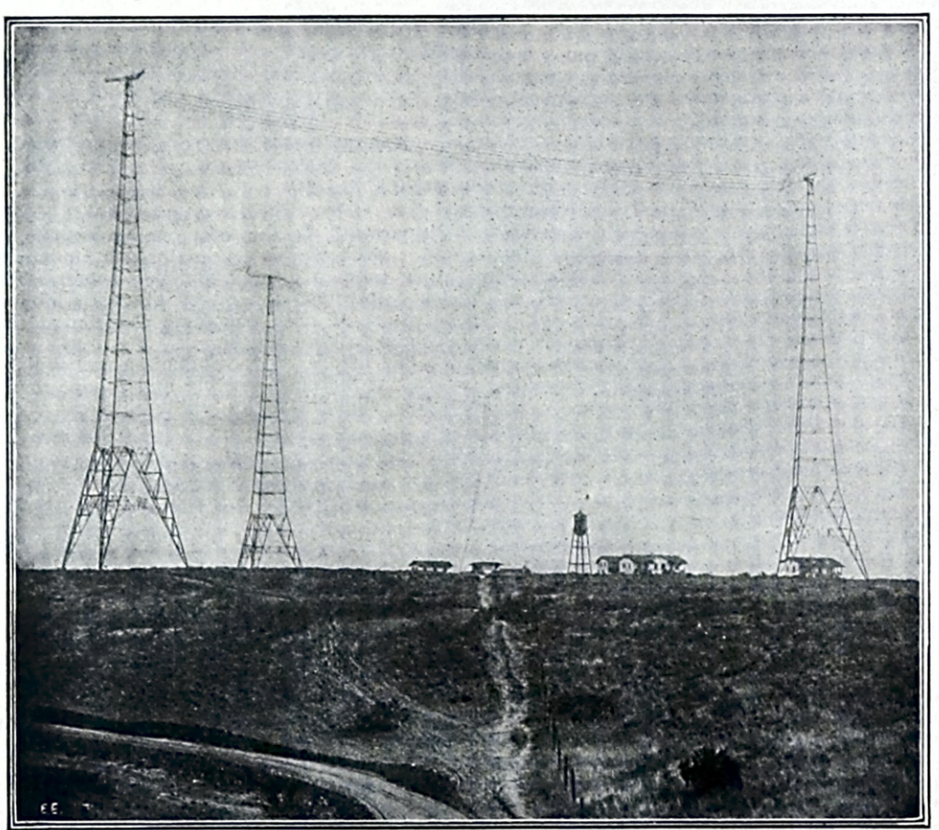


Photo by Central News Photo Service.

A View of Uncle Sam's New $300,000 Naval Radio Station at Chollas Heights, Near San Diego, Cal., Which Was Placed In Commission on January 26th Last. The Commanding Officer's Quarters Is Seen at the Base of the 600-Foot Tower on the Right.

The three towering aerial masts rise to a height of 600 feet, and involve 1,000,000 pounds of structural steel in their make-up. The aerial wires alone weigh 16 tons. The aerial towers are 1,100 feet apart and form a huge triangle. Triangular in form, the masts measure 150 feet between the legs at the base and 8 feet across the top. They rest on gigantic insulators at the base. The *ground* connection required 25 miles of piping and copper cable. Most of the ground will be kept constantly damp by means of the piping. The power plant comprises a 300 H.P. 2,200-volt, 60-cycle induction motor driving a 200 K.W. 1,000-volt, D.C. generator, which supplies a Federal-Poulsen arc transmitter of this rating. The tuning helix for the arc is 14 ft. in diameter and 11 feet high. The station is erected on a land reservation totaling 72 acres.

AUTO BATTERIES SUPPLY RADIO SET IN EMERGENCY.

The following is an extract from the report of Radio Operator Willard Ferris, of the steamship *Carolina* of the Goodrich Transit Co., which met with an accident on December 3, 1916, running aground on Stony Creek Reef and springing several plates. The vessel is voluntarily equipt with radio apparatus and is not supplied with an auxiliary source of power supply:

"The power went off at seven p.m. and the Manitowoc station called at frequent intervals until ten p.m., and from that time until eleven p.m., the Ludington and Milwaukee stations called, but I was unable to answer them as there was no power. About eleven o'clock, with the permission of the captain and the assistance of some of the crew, I removed the storage batteries from the six automobiles which were on board.

"I wired these batteries in series, obtaining a total voltage of 36. The transmitter was of the one-half kilowatt, 120 cycle, panel type, and by adjusting the rheostats for full power and using six plates in the quenched gap a reading of one-fourth ampere on the hot-wire ammeter was obtained and communication was established with Ludington, a distance of about 75 miles.

"It was necessary to short circuit the automatic starter, as there was not enough power to raise the solenoid, and to substitute a wire for the generator field switch, in order to disconnect the motor running the quenched-gap blower and save all the power for the operation of the motor generator. The batteries were restored to the automobiles the following afternoon when the cars were placed aboard a relief vessel."

RAILROAD MAY OPERATE TRAINS BY RADIO.

If experiments now going on at the operating headquarters of the Frisco railroad in Springfield, Mo., are successful, wireless telegraphy may become a valuable asset in the operation of trains over that system.

H. D. Teed, superintendent of telegraph of the Frisco, has installed a wireless apparatus at Springfield and messages have been heard from government stations at Arlington, Key West and from a fruit dispatch boat on the Gulf of Mexico.

A year ago the wire service of the Frisco was badly interrupted by sleet and floods, according to an announcement from the general offices in St. Louis. Since then Mr. Teed has been experimenting with wireless, and in many ways it is said to have proven successful.

California Youth Invents Radiotelephone System

EARL C. HANSON, of Los Angeles, California, has earned a place in the hall of fame by inventing a compact radiotelephone system having unlimited possibilities.

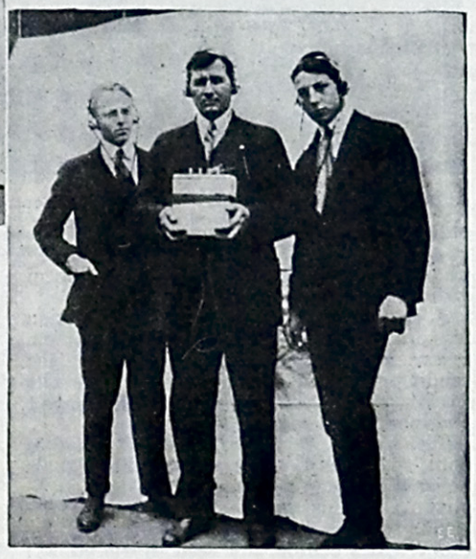
Mr. Hanson, comparatively, is a mere youth, as he recently celebrated his twenty-third birthday. At the age of ten he began his experiments. To-day he is still experimenting, but patent papers awarded by the United States government, following several years of litigation wherein Marconi and other wireless inventors figured, are positive proof that he has arrived at the station known as "Success."

By the use of apparatus invented by Mr. Hanson, it is now possible to send a wireless telephone message from an automobile going a mile a minute, to a point five, ten or a hundred miles distant.

With this apparatus two of Uncle Sam's warships can carry on a wireless telephone message, at any distance, use plain English instead of a code, and feel assured that no other wireless station can pick it up.

The Accompanying Pictures Show a Variety of Ways In Which the New Hanson Radiotelephone System Can be Used. Above, a Patrolman, Using the Wireless Telephone While on His Beat, to Answer a Call from Headquarters. Its Possibilities in This Direction Alone are Limitless.

At the Right, a Portable Radiophone Field Set, Which Could be Used by Scouts During War Times. Note the Extreme Compactness of the Hanson Apparatus, Enabling it to be Carried About in a Hand-Bag or on the Back.



The Hanson Wireless Telephone Laboratory, Showing Tuning Cabinet and Special Compound Heavy-Current Microphone. The Victrola at the Extreme Right Is Used for Transmitting Music via Wireless.

These are only two of many uses to which the invention of this Los Angeles youth can be put, but many others equally valuable will immediately suggest themselves.

With this apparatus in your reception-room it is possible to reproduce any song or instrumental selection your guests may call for. If one of them suggests he would like to hear Caruso sing, the great tenor will oblige before the guest has finished his request, and this without the host leaving his chair, or making a move, or uttering a word. Here is the explanation:

From another room, or from another house, some one operating a phonograph, hears the request by use of a dictagraph placed back of a picture in the reception-room. The machine is started, the wireless apparatus conveys the music to an instrument in the reception-room called an *audiotone*, and the guests listen to the sweet tones of the singer.

With one of these instruments in your auto, and another in your home, you can call up your wife when you are well on the way, and tell her to put the tea kettle on. Also, she can reverse the call, and tell you to go back to the city and get a spool of thread and a pound of butter, which of course you have forgotten.

You can talk to the man in a flying machine a mile high, and fifty miles away. Or he can call you, as the case may be.

Recently the writer visited this young inventor, and enjoyed an hour or two with him in his laboratory. Worden Crumley, a young friend of Mr. Hanson, volunteered to take charge of the sending instrument, and Mr. Hanson and the writer went for a walk around the block, carrying with us a small box about ten inches square and two inches thick. Two receivers were attached to the box with insulated wires, about five feet long. With the receivers to our ears we strolled down the street, and listened to a wireless reproduction of one of McCormack's great song hits.

Then, to vary the program, Mr. Crumley told a story by wireless, and every word was heard as distinctly as tho coming over the ordinary telephone.

This device may also be used to advantage by patrolmen, regardless of whether they are located within the city or in outlying districts. While making his rounds the patrolman may carry his combined sending and receiving set on his bicycle or slung over his shoulder, a receiver at all times being attached to one ear. A resident on this patrolman's *beat* telephones by wire to Central Station that a robbery is being committed close to his home and that help should be sent at once. The operator at Central Station immediately calls the patrolman by *wireless*, no matter at what part of his beat he happens to be, and he at once hurries to the scene, which may be but a few hundred yards distant. This does away with sending men from Central Station for miles into the suburban districts to answer whatever calls may come in from those sections.

Municipal wireless phonograph concerts may also soon be a reality. For these a single centrally located sending station would be necessary, the waves from this having a radius of the entire city. At a given time each evening all the residents of the city might, by the use of a receiver and ear tubes or a receiver connected to a phonograph horn, enjoy the concert as it is played into the transmitting apparatus at the sending station.

Mr. Hanson's wireless telephone differs from any other invention along this line, in that it employs a low frequency and low voltage as distinguished from the high frequency and high voltage of the wireless inventions of Marconi, Poulsen, Fessenden and de Forest. This wireless 'phone uses fifty volts whereas the other existing wireless telephones require from 25,000 to 100,000 volts. No arc or spark are used in the Hanson system, and the waves of this system are not affected by static its inventor claims.

Often high voltage and high frequency systems are rendered ineffective by electrical storms. This is caused by the electricity or waves in these storms being of the same character as that of the high voltage systems. As the low frequency waves are entirely different from those of the high frequency they are not affected by atmospheric conditions.

INSTITUTE OF RADIO ENGINEERS FEBRUARY MEETING.

The Institute of Radio Engineers held their monthly meeting on Wednesday evening, February seventh, at the Engineering Societies Building, New York City.

A paper on "The Influence of Commercial Conditions on Transmitter Construction" was presented by Mr. Julian Barth. Mr. Barth described four interesting types of radio transmitters, including cargo ship sets, special land station sets and moderate high power land station sets. The paper was well received by an enthusiastic audience.

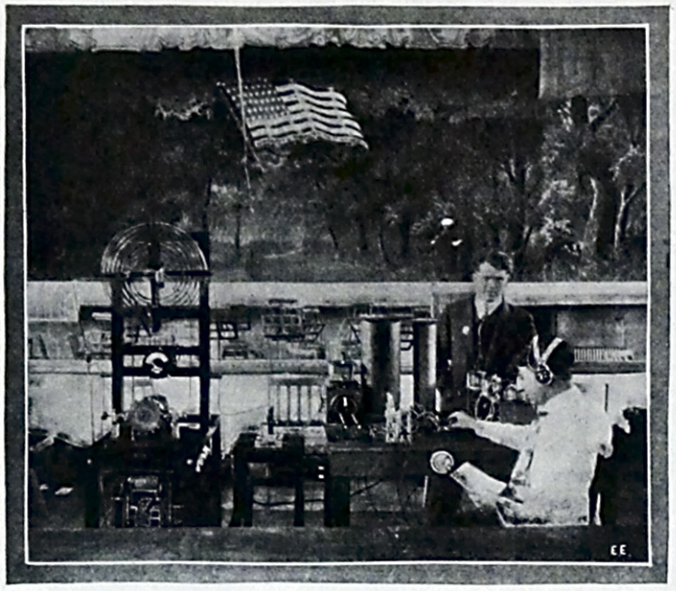
ELECTRIC POWER CO. USES RADIO.

The Arkansas Light and Power Company, of Arkadelphia, Okla., has installed a wireless station at its headquarters. The aerial extends from the top of the local hotel to the top of a bank, a distance of 300 feet. The wires are 100 feet above ground. Application may be made for a government license to operate transmitting apparatus. Messages have been received from more than 1,000 miles away and watches were set by time given from the Arlington station, Virginia.

The Western Union Telegraph Company has announced that all wireless messages to be sent by the way of the Tuckerton station would be refused. Only official government and embassy messages will be received.

RADIO EXHIBIT AT THE KANSAS ELECTRICAL SHOW.

ONE of the most successful radio exhibits of the mid-West was made at Wichita, Kansas, during the Electrical Show. This exhibit was in charge of Mr. Don I. Shepherd, manager, and Charles A. Stanley, engineer, of a local radio company.



A Corner in Radio Display at Kansas Electrical Show, Wichita, Kansas, Showing the Sending and Receiving Set. Mr. Don I. Shepherd, Manager of the Cos-Radio Company and Mr. Geo. Marshall, First Grade Operator.

A complete sending and receiving station was in operation, including a Thordarson, 1 k.w. transformer, the remainder of the sending set being of Cos-Radio make. The receiving set was arranged for both damped and undamped wave reception.

The public were permitted to listen to both spark and arc stations, the signals being amplified by means of a Multi-audiphone amplifier and horn.

The following messages were received by the Wichita station and read to the public:

New York, December 6th.

Greetings to the Kansas Electrical Show. Let there be co-operation between the electrical people and continuation of our country's electrification until electricity is the universal and only power.

(Signed) Chas. P. Steinmetz.

New York City, December 7th.

Western Electrical Show. We are all fortunate in being in the business of bringing about the further application of electricity, for even tho we may be reaping a personal profit it is small compared with the benefits realized by further and further uses of electricity and so we may freely feel that we are benefactors of mankind.

(Signed) Henry L. Doherty.

These messages were relayed to Wichita by the Illinois Watch Co. (9ZS).

One interesting feature of the exhibit was the display of amateur apparatus, a prize having been offered for the best single piece of apparatus and a second prize for the best complete set. Mr. Elmer Showalter of Moundridge received the prize of a loose coupler and C. B. Callinder of Wichita received the prize for the best sending and receiving set.

The purpose of the radio exhibit was to show to the public the various apparatus used in radio work and to increase interest in wireless among amateurs.

SEALS ALL AMATEUR STATIONS ALONG GULF COAST.

The customs collector of the Sabine district has sealed all of the amateur wireless stations in this district and they will remain sealed indefinitely. The wireless stations of the refineries which are used to communicate with their ships at sea will not be closed.

An investigation by Chief Hansen, local navy recruiting officer, revealed the fact that there are twenty-one stations in this district capable of receiving wireless messages, and all of these except a few being capable of also sending messages.

The closing of the amateur receiving stations will prevent the movement of war vessels becoming known generally. The activities of foreigners have made necessary these measures on the part of the Government officials.

AN EFFICIENT BATTERY-TYPE RADIO TRANSMITTER.

The yachtsman of to-day need not limit the extent of his voyage no matter what size boat he possesses, for Mr. A. B. Cole, a radio engineer of New York, has solved the problem of supplying small sailing and motor driven vessels with a thoroly efficient radio transmitter and receiver which can be operated from a storage or dry battery.

Heretofore, difficulties were encountered by small sailing boats in communicating with coast stations or vessels of larger size which are usually fitted with expensive radio outfits, for the reason that it was impossible to obtain a suitable transmitter for the necessary communication purposes.

Several battery-operated transmitters have been previously designed but they proved a failure an account of the inefficient and irregular results which they gave. However, all of these defects have now been entirely eliminated in Mr. Cole's radio-transmitter which embodies several improvements to facilitate the simplest operation of this outfit, which, by the way, is portable.

The accompanying photograph shows the complete equipment. The transmitter consists essentially of a special spark coil operated set. The coil is of special design and will give a high output with a very small input, and the vibrator is so made that it will emit a pure musical note. In its final adjustment the transmitter gives a tone corresponding to the frequency of 250 cycles. The coil is mounted on a Bakelite panel with the additional instruments shown. In this outfit, the oscillating circuit is the same as in standard radio transmitters, inasmuch as a spark gap, condenser and inductance are employed. The discharge takes place in a quenched gap which may be seen at the center of the panel. It consists of two heavy metal plates accurately machined and supported on two standards. A large sparking surface is used in this gap, which was found to give the best results.

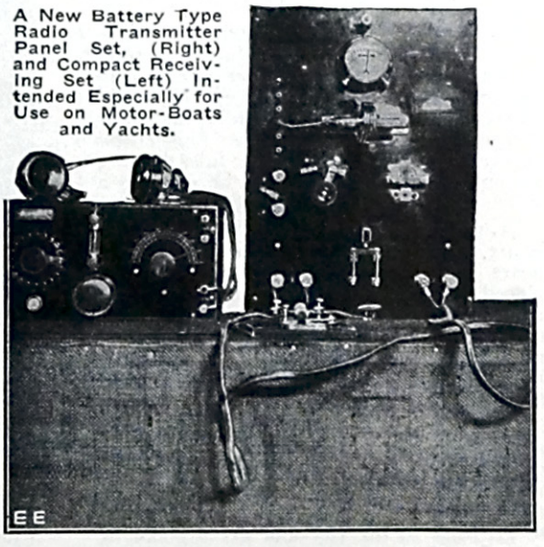
A high tension condenser is employed, and this is placed behind the panel. The aerial tuning inductance is also mounted on the rear. Various steps on the inductance are obtained by means of five jacks, which are connected to the different sections of the helix. Different taps are connected by means of a plug connected to one lead from the quenched spark gap, as noted in the photograph. A hot wire ammeter is included for indicating the amount of current flowing into the antenna; this is located on top of the panel. The binding posts of this meter are used to connect the transmitter with the aerial. A switch for changing from receiving to sending or vice-versa is shown on the left center of the panel. It is of the single rotary blade type, operated by an insulating knob. The lower switch is used for connecting the power supply with the instruments. The two binding posts to the left are for power supply, while those to the right are for connecting the key. Ground connection is obtained thru the lower left center binding post.

The receiving set is of a cabinet type, seen on the left. This consists of a loosely coupled tuner, the primary of which is regulated only, while the coupling is controlled by means of a slide rod not shown. A variable condenser is also used, the adjusting knob and scale of which may be seen on the right of the outfit. The crystal type detector and buzzer adjustment, here used, are mounted on the front panel of the cabinet. Standard high resistance radio telephone receivers are employed.

A series of experiments were conducted with this outfit and it proved to be very efficient, it having been found possible to transmit thirty miles with an input of only twenty-four watts on a 12-volt battery, and employing an antenna having a natural period of 200 meters. The tone emitted by the transmitter corresponds to a frequency of 250 cycles and its wave has a decrement of .2 which is the value permitted by the United States Government.

The extreme lightness and compactness of this outfit makes it invaluable as a portable military set. With its use, there is eliminated the cumbersome generator and the two men needed for driving the same. Only three men will be needed to carry the complete equipment; one for the outfit, the second carrying the battery while the third handles the antenna system.

It can be used with great success in conjunction with military ambulance work which necessitates some means of communication at all times, and there is no doubt in our minds, that it will be utilized for this purpose in the future.



A New Battery Type Radio Transmitter Panel Set, (Right) and Compact Receiving Set (Left) Intended Especially for Use on Motor-Boats and Yachts.

Besides being extremely compact the set designed by Mr. Cole possesses the merit of distinct simplicity, both in transmitting and receiving.

The Early Days of Radio in America

By DONALD McNICOL, Mem. I. R. E.
Assistant Electrical Engineer, Postal Telegraph-Cable Company

THE history of an art or a science, like that of individuals, is not of much general interest until the subject has attained permanent prominence. The historical development of a particular branch of science, such as radio telegraphy, in order to be complete and of instructive value should, if possible, be traced thru the personal connection therewith of all of its pioneers.

So called official records alone are not sufficiently comprehensive. Many of the most illuminating essentials of historical narrative escape the observation of the official compiler and, in so far as radio is concerned, I believe it to be the duty of those acquainted with views and facts of its introduction to set these down for the inspection of the ultimate historian. To the extent this is done will be lessened the possibility that some item of value may be lost to the written records.

In February, 1896, Guglielmo Marconi journeyed from Italy to England for the purpose of showing the British telegraph authorities what he had developed in the way of *operative* wireless telegraph apparatus. His first British patent application was filed on June second of that year.

Thru the cooperation of Mr. W. H. Preece, chief electrical engineer of the British Post-office Telegraphs, signals were sent in July, 1896, over a distance of one and three-fourths miles on Salisbury Plain.

In March, 1897, a distance of four miles on Salisbury Plain was covered. On May thirteenth of that year communication was establisht between Lavernock Point and Brean Down, a distance of eight miles. During this latter demonstration Prof. Slaby, of Germany, was present as a spectator.*

In America, (1890-1896), many students of science were in touch with the discoveries made in Europe during this period; but it was not until 1897 that the utilitarian American mind sensed the commercial possibilities of the advances being made abroad.

In its March, 1897, issue *McClure's Magazine* presented a long illustrated article entitled "Telegraphing Without Wires," by H. J. W. Dam, describing the experiments of Hertz, Dr. Chunder Bose, and the youthful Marconi.

Telegraph Age, New York, in its issues of November 1 and November 15, 1897, reprinted a long article from the London *Electrician,* entitled "Marconi Telegraphy." This article consisted chiefly of the technical description which accompanied Marconi's British patent specification number 12,039 of 1896.

In October, 1897, *Scientific American* published an instructive editorial dealing with the status of Wireless Telegraphy. The article discust Nikola Tesla's work, his claims and his prophecies, also the reports of Marconi's experiments with induction coils and coherers.

*Dealing only with the *Art* of wireless telegraphy we can reasonably omit reference to the work of Joseph Henry, in America; Hertz' work; the development of coherers; and Sir Oliver Lodge's famous lecture of 1894.

The *Journal of the Franklin Institute,* in December, 1897, covered practically the same ground.

In the year 1898, Mr. William Maver, of New York, read a paper on wireless telegraphy at the annual convention of the Association of Telegraph Superintendents, at Wilmington, N.C. The information communicated was in the main a review of Dr. Marconi's early work.

In the June, 1899, issue of *McClure's Magazine* there appeared a long illustrated article by Cleveland Moffatt, entitled "Marconi's Wireless Telegraphy." In this article the cross channel tests were described in a popular, semi-technical manner.

VERY few of our younger radio readers can recall the important events of the early days of radio in the United States most probably. We feel certain that you will be greatly interested in this timely contribution to radio history by Mr. Donald McNicol, who was actively interested in the early-day developments of Marconi, Lodge, Fessenden, de Forest, Stone, and other leading lights in this now distinct branch of applied science. Do you know when the first wireless text-book appeared in this country? When the first U. S. Navy instruction book was publisht? Who sold the first "coherer" sets for experimenters?—Then read Mr. McNicol's article.

American technical magazines at first were somewhat slow in grasping the significance of the work being done in Europe; their references to the subject consisting mainly of brief reviews of articles appearing in foreign periodicals, with the result that American telegraphers of an experimental bent were supplied with but meager information, and that not of much practical value.

In its February 16, 1899, issue *Telegraph Age,* New York, printed an elementary article by Willis H. Jones, which was the first really lucid description of the system served to American telegraphers.

In July, 1899, the *American Electrician* published a complete semi-technical description of Prof. Jerome J. Green's demonstrations of wireless telegraphy at Notre Dame University, Montreal, Canada. This article was hailed as a great find by amateurs, and in various parts of the country demonstration sets were made up, operated and exhibited.

In September, 1899, during the International Yacht Races off New York harbor, the steamer *Ponce* was equipt with radio apparatus by Marconi, for the purpose of transmitting reports of the progress of the race. Two receiving stations were equipt; one on the Commercial Cable Company's cable ship *Mackay Bennett,* stationed near Sandy Hook, and connected with a land line station on shore by means of a regulation cable; the other at Navasink Highlands. This demonstration, altho not highly successful, immediately brought the subject to the fore in this country.

In 1900, the erection of the first Marconi station at Cape Cod, Mass., was begun.

In the fall of 1900, the author of this paper constructed the first amateur wireless set used in the twin cities, Minneapolis and St. Paul, Minn. Later he exhibited the first sets shown in the cities of Butte, Mont., and Salt Lake City, Utah. In later years thriving radio clubs have grown up in these various centers.

In 1900, Mr. Thomas E. Clark, of Detroit, Mich., began the manufacture of radio apparatus. Handsome catalogs were issued illustrating *coherer* and *register* sets. One of Mr. Clark's assistants was Mr. J. Z. Hayes, chief operator of the Postal Telegraph Company, Detroit.

In March, 1901, the Marconi Company installed apparatus at five stations on as many islands of the Hawaiian group. For a long time these installations were of little value due to a scarcity of competent operatives.

During this year the Canadian government installed two stations in the Strait of Belle Isle; the New York *Herald* stations at Nantucket, Mass., and Nantucket light ship.

The crowning radio event of the year was the reception by Dr. Marconi at St. Johns, Newfoundland, of the now famous letter "S," transmitted as a test signal from his English station; this was on December 11, 1901.

The most important published article on radio during 1901 was that of Reginald A. Fessenden, which appeared in the *Electrical World* of June twenty-ninth. Prof. Fessenden was at that time connected with the United States weather bureau, and his communication described the work accomplished by him under the direction of Prof. Moore, beginning in January, 1900. The article contains an interesting exposition of *Syntony* as at that time understood.

In its February 9, 1901 issue, *Collier's Weekly* contained a long illustrated article by Dr. Nikola Tesla, entitled "Talking With the Planets." The *Scientific American* of March ninth published a complete account of the so-called Slaby-Arco system of wireless telegraphy, and the same magazine in its December twenty-eighth issue, gave further details and illustrations of Slaby-Arco equipment. These articles were written by A. Frederick Collins.

In 1902, the Canadian Marconi Company was formed, as well as the American Marconi Company.

On January thirteenth, Dr. Marconi delivered a lecture to the members of the American Institute of Electrical Engineers at New York, describing his system, and gave an account of the progress made up to that time.

J. H. Bunnell & Company's catalog of 1902 lists a page of wireless goods. A relay, coherer, and tapper receiving outfit was listed at $25.00.

On September first Prof. Fessenden's contract with the U. S. Government expired. He then established headquarters in Pittsburgh, Pa., and began a series of careful investigations which led to important results.

In 1902, the United States Signal Corps established stations at Sandy Hook, N.J., and at Fort Wadsworth—twenty-two miles apart. The operators in charge were Messrs. L. E. Harper and C. J. Applegate. The instruments at first employed were manufactured under the direction of Dr. Lee de Forest, who had been developing new ideas during the two years previous. The detector consisted of *two aluminum rods with a steel needle laid across them,*

(Continued on page 911)

The Calculation and Measurement of Inductance

By H. WINFIELD SECOR and SAMUEL COHEN

Part II

IN the last installment we considered the calculation of inductance while in this issue we shall confine ourselves to the measurement of inductance.

There are several methods which have been adopted for the measurement of this important quantity and the most practical and simple ones will be discust here.

The inductance of a coil which is connected in a low frequency circuit can be determined by connecting it as indicated in Fig. 1. A is the source of alternating current the frequency of which is known, R a variable resistance or variable impedance coil for controlling the current, Am and Vm are A.C. ammeter and voltmeter while L is the coil, the inductance of which is to be measured. The connections of the various instruments should be properly made. In the act of measuring, care should be taken to see that the meters indicate maximum deflection before opening the circuit.

The observed indications of the meters are then substituted in the following equation:

$$L = \frac{1}{\omega}\sqrt{\frac{E^2 - I^2R^2}{I^2}}$$

Where

L=Inductance of the coil in henries

E=Indicated voltage

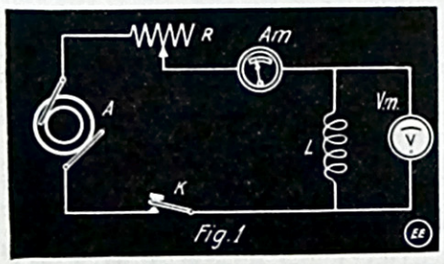
I=Indicated amperage

R=Resistance of the coil in ohms; this value can be obtained by measuring it with a Wheatstone bridge.

ω=Angular velocity which is equal to (3.1416x2) × the frequency. If an alternating current generator is used the frequency would be $N=\frac{NS}{120}$

N being the number of poles of the alternator and S the number of revolutions per minute.

The above method is applicable in measuring the inductance of coils up to .02 henries, when employing frequency of 25 to 60 cycles, if a higher frequency is used such as 500 cycles, the scheme can be used to advantage to measure the inductance as high as .004 henries. The latter coils, however, are those which are of the air core type, while those of the former are of the magnetic core type, such as employed in impedance reactance coils.



Simple Method of Measuring and Computing Inductance of a Coil by Connecting It to An Alternating Current Circuit with a Volt and Ammeter.

The inductance of magnetic core coils is sometimes very important, especially when it is desired to determine the total impedance of the primary side of a transformer which is connected in series with a variable resistance. The expression for such a circuit is:

$$Z = \sqrt{R^2 + \omega^2 L^2}$$

Where:

Z=total impedance

Photo Showing Several Types of Radio Inductances and Wave Meter as Used for Measuring the Value of the Inductance of Such Coils.

R=the resistance of the total electrical circuit (primary)

ω=angular velocity (2πN)

N=frequency in cycles per second

L=inductance.

We shall next consider the measurement of inductance by a Wheatstone bridge, which is usually in the experimenter's laboratory and if he does not possess one, we refer him to the September, 1916, issue of this journal. The schematic connections of the Wheatstone bridge as used in this measurement is shown in Fig. 2, while Fig. 3 shows the connections of a slide wire bridge.

Referring to Fig. 2, the resistance arm D should be a plug resistance, having a range from 0 to 20,000 ohms and the condenser C should be of the variable air-dielectric type, while the series variable resistance P should be about 4,000 ohms for its maximum. The coil the inductance of which is to be determined is placed across the terminals marked XX of the bridge. The resistance of the coil is to be known, and this is obtained by measuring it on the same or a different bridge. Across the arms of the bridge is shunted a high frequency buzzer in series with several batteries and key K, while across the neutral point, the resistance P and galvanometer G, telephone receiver T and key K¹ are connected as indicated. Where the bridge arms or inductance have a high resistance, it is necessary to employ a buzzer inductively connected thru a telephone or medical induction coil as indicated by the dotted lines in Fig. 2.

The first object in the procedure is to obtain a steady balance on the bridge. The resistance P and condenser C being removed, the resistance arms ABD are varied until a minimum sound is heard in the receiver T, while the bridge is being excited by the interrupted current of the buzzer. As soon as this balance is obtained, the resistance P and capacity C are reinserted. It will be found that when the galvanometer key is first closed and then the battery key, the galvanometer coil is found to be in motion, thus indicating that the balance is not precise, but this may be annulled by varying P and C until the kick of the galvanometer is entirely eliminated. A still finer balance can be obtained by using the (75 ohm) telephone receiver instead of the galvanometer. It should be remembered that when using the galvanometer for the indicating device that more battery should be employed as the time-constant of the galvanometer is slow, compared with that of the vibration of the buzzer.

Having observed the values of the arms of the bridge, capacity of condenser and resistance of P, they are then substituted in the following equation, which is a relation of inductance of the coil to that of the other factors, thus we have:

L=C [P(R+D)+AR]

L=Inductance of coil in microhenry

C=Capacity of condenser in microfarads when point of balance is obtained

P=Resistance in ohms

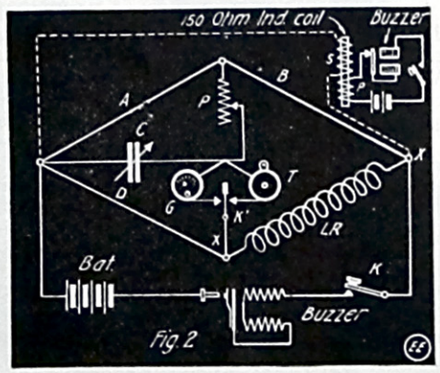
R=Resistance of coil, the inductance of which is to be determined.

AD=Resistance of arms of bridge.

[When it is desired to have the unit of measurement in millihenrys, it is necessary to divide the result obtained by 1,000 or by 1,000,000 to reduce it to henrys.]

The same procedure should be followed when using the slide wire type of bridge, the only change in operation being to move the slider S along the wire until resonance is obtained (see Fig. 3). The known resistance D should be of the non-inductive box type and should have a capacity of 40,000 ohms, varying at intervals of 100 to 200 ohms per plug.

Another method of measuring inductance is by means of the Siemens and Halske inductance bridge.* A wiring diagram of this type of instrument is shown in Fig. 4. It consists of a standard slide wire bridge shunted by a buzzer, transformer (see Fig. 2, also) and battery. The arms of the bridge are linked with the unknown inductance Lx, which is connected in series with a small variable resistance R. An additional variable resistance S is connected as shown and usually consists of a plug resistance box. This resistance ranges from

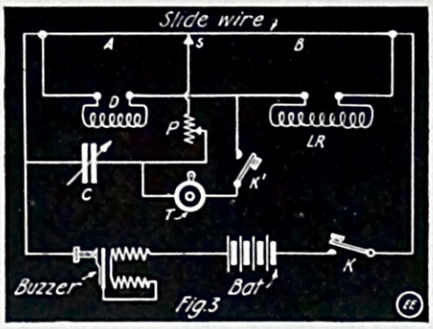


Wheatstone Bridge Arranged with Buzzer Excitation for the Measurement of Inductance by the Fleming-Anderson Method.

one-tenth to five-tenths of an ohm. The standard inductance I is of special con-

*See article by Dr. A. N. Goldsmith in *Wireless Age* for April, 1914.

struction, it consists of a small coil into the center of which an iron core C of suitable shape is placed. The core is



Utilizing a Slide-Wire Bridge for the Measurement of Inductance. Principle Followed in the "Sage Ohmmeter" for Measuring Inductance by Comparison.

placed on a movable rack so as to permit the core to be moved in or out of the coil at will. Thus by allowing the core to be wholly in the coil the inductance will be maximum; in this manner the inductance of the coil is made variable by means of this ingenious variable core arrangement. The iron of the core C is made from a number of iron wires finely divided and imbedded in paraffin wax. In this way the core is made to have very small alternating field losses, such as hysteresis and eddy currents. The alternating current for the bridge is derived from a buzzer linked across the bridge as indicated. The indicating device consists of a telephone receiver.

The general procedure in measuring inductance with this type of bridge is as follows: The alternating current source is connected so as to excite the circuit and then closing the telephone receiver switch K^1, the slider U is adjusted to obtain as nearly a minimum sound in the receiver as possible. In order to further reduce the intensity of the sound the resistance R and S are adjusted, also the core C of the standard inductance coil I. When the position of resonance is obtained, the inductance of the unknown coil Lx is derived by substituting the observed values in the following expression:

$$Lx = \frac{a}{b} I$$

Where

Lx=Inductance of the unknown coil
a=Length of one side of wire
b=Other length of wire
I=Inductance of the known coil.

It should be remembered that in using the known inductance that it is necessary at first to standardize this coil with respect to every position of the iron core within the coil, before it is possible to use it as a standard. In actual practise this coil is supplied with a calibration curve showing the value of the inductance with every position of the core. The measurement of inductance with this method is accurate within one-half of one per cent.

Having described the general method of measuring inductance by means of the various methods of the employment of the Wheatstone bridge, we will now discuss another well-known method of performing this measurement. This is dependent upon the resonance of two coupled circuits. In utilizing this scheme there are required two standard calibrated variable condensers, one standard inductance, an exciting apparatus such as a buzzer, and a receptor consisting of a crystal detector and telephones and connected as shown in Fig. 5. The procedure with this arrangement is this: the circuit L_2C_2 is excited by means of the buzzer and the coupled circuit L_1C_1 is tuned to resonance by noting the maximum sound in the receptor circuit. In this connection the switch is so placed that inductance L_1 only is in the circuit. The position of resonance of the condenser scale is noted and marked as Ca. The switch is then changed so as to connect the unknown inductance X in the circuit and the resonance position is again obtained and call this position on the condenser scale as Cb. Since resonance existed in the coupled circuit, their relation can be exprest as

$$C_a L_2 = L_1 C_1$$

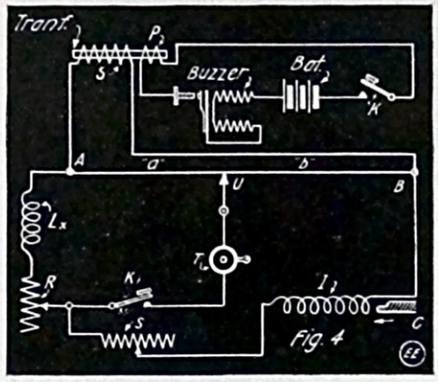
which is the expression for the first position of resonance, but as soon as the unknown coil was added then we have

$$(L_1 + X) C_1 = L_2 C_b$$

Solving for the unknown inductance X we have

$$X = \frac{L_2 (C_b - C_a)}{C_1}$$

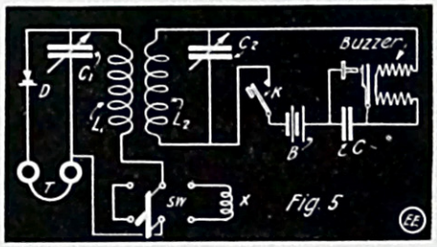
which gives the value of the unknown inductance in terms of the capacity of one of the condensers and the standard induc-



Arrangement of Siemens-Halske Inductance Bridge Having a Calibrated Coil Provided with an Adjustable Iron Core. Excitation by Induction Coil and Buzzer.

tance. It is advisable when using a buzzer exciter that it should be of such construction as to produce a fairly high note.

It sometimes happens that the induc-



How the Wave Meter, with Known Inductance L_1, Is Employed to Measure Value of Coil L_2. Buzzer Excitation Is Employed.

tance of an antenna is required and for this determination the following data will be necessary:

Inasmuch as inductance is a factor of wave-length of the antenna system and since it possesses capacity with respect to the earth, it seems therefore possible to determine one of these units if the other is at hand. The well-known formulae for expressing the capacity of an aerial in terms of its wave length and inductance is herewith given:

$$C = \frac{\lambda^2}{36\pi^2 \, 10^{10} L}$$

Where:

C=Capacity of the antenna system in farads
L=Inductance in henrys
λ=Wave lengths in meters.

Or, solving L in terms of its capacity and wave length, we get

$$L = \frac{\lambda^2}{36\pi^2 \, 10^{10} C}$$

The connections for this measurement are indicated in Fig. 6. The antenna is excited by means of a buzzer which is shunted with a condenser C. This is used for charging and discharging the antenna. La and Lb are two known inductance coils which are inserted at different times, L is a coupling coil which consists of one or two turns of wire. This coil is placed in proximity to the coil which constitutes the inductance of a wave meter, coupled with a variable condenser C_1 and a responsive device D and T, which are a crystal detector and telephone.

In the actual measurement the antenna system is excited by starting the buzzer, and the natural wave length noted. Then the additional inductances La and Lb are added and the corresponding wave lengths are obtained. The coupling between the coils should be kept as loose as possible in order to obtain a more accurate resonance position. Having obtained the two corresponding wave lengths and knowing the values of the two standard inductances La and Lb, we can then readily obtain the inductance of the antenna system by substituting the values in the following equation:

$$Lx = \frac{\lambda^2 (L_b - L_a)}{(\lambda_b^2 - \lambda_a^2)}$$

Where:

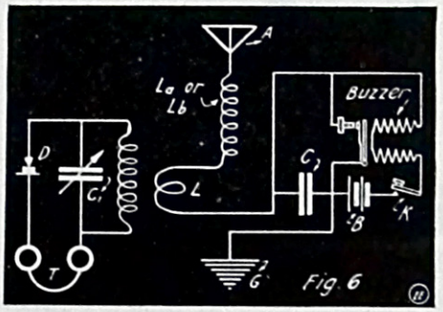
Lx=Inductance of the antenna
λ2 =Natural wave length of the antenna
La=Inductance of one standard
Lb=Inductance of second standard
λa =Wave length when coil La is in circuit
λb =Wave length when coil Lb is in circuit.

The method just outlined for the measurement of the aerial inductance is not very accurate on account of the varying distribution of potential and current along the antenna at the different wave lengths used. It is very difficult to overcome these defects in this kind of work; in fact, it is the most difficult quantity to measure accurately in radio work. The measurement of inductance is very important in all radio work and the novice should not lose sight of its importance.

NEW HAVEN Y.M.C.A. RADIO CLUB ACTIVE.

Members of the New Haven, Conn., radio club recently erected a two strand aerial for their wireless station, 450 feet long, reaching from the Hotel Taft to the Y.M.C.A. building. It is believed that with this equipment messages from Germany may be heard.

Six members have successfully applied for licenses as wireless operators and there is a total membership of twenty-five. No sending set has been put up in the rooms of the local club, but it is probable that one will be installed in the near future.



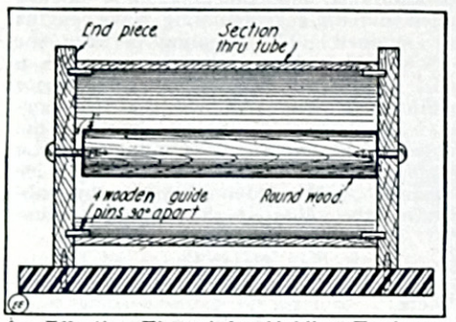
Utilizing the Wave Meter to Ascertain the Inductance of a Radio Antenna. The "Exciting" Inductance Consists of a Turn or Two of Wire "L," Which Is Connected in the Aerial Lead as Shown. A Buzzer and Condenser "C" Serve to Excite the Aerial Circuit.

SUBSTANTIAL TIE-ROD FOR TUNING COILS.

The illustration shows a good method of making a tie-rod for tuning coils. All that is needed is a piece of broom-handle and two stout wood screws. The rod should be cut about ¼" shorter than the tube, as shown at A. The end at B. should be screwed up tight first. Then the tube is slipped over and the other end screwed up. Four wooden guide pins should be doweled in each end frame to keep the tube in the proper position.

The coil I have, made in this way, is very satisfactory.

Contributed by
WILLARD HUNGERFORD.

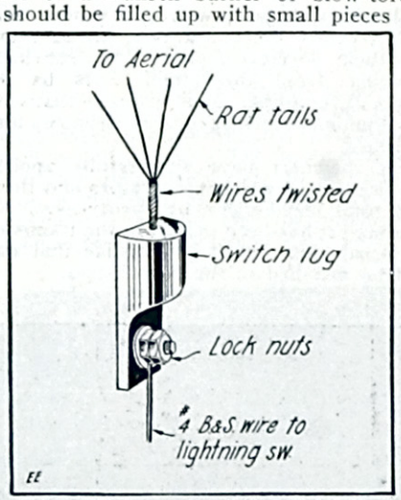


An Effective Tie-rod for Holding Tuning or Loading Coil Frames Together With. The Tie-rod Is Cut a Little Shorter Than the Distance Between the Coil Ends.

FIRST-CLASS RAT-TAIL CONNECTOR.

As shown in the drawing, this connector consists simply of a switch-lug, the four (or any number) of wires from the aerial being soldered to the lug, and the single No. 4 lead-in wire fastened by means of a machine screw. The whole joint is then taped up with rubber (gum) tape to prevent corrosion.

In soldering, a few words as to how to do it correctly will not be amiss. The wires from the aerial are twisted together for an inch or so, at one end. This end is then scraped thoroly, and a little soldering paste is rubbed on it. Now clean out the inside of the lug and put a little paste in it also. The lug is then held in the flame of a Bunsen burner or blow-torch. It should be filled up with small pieces of



For High Efficiency the Rat-tail Leads from an Aerial Should Be Soldered to the Lead-in Wire. A Switch Lug Makes a Good Joint.

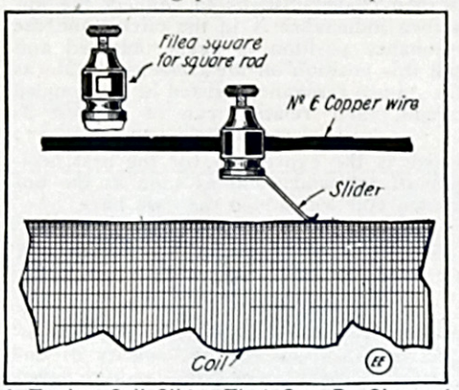
solder before placing it in the flame. When the solder has melted the twisted wires are pushed in and water thrown on the lug to cool it off quickly. The result is a perfect joint. The heavy lead-in wire from the lug is fastened with a brass machine-screw, inserted in the hole in the lug.

This is a sure connector, and for cheapness and neatness can't be beat.

Contributed by FRANK TALONE.

TUNING COIL SLIDER MADE FROM BINDING POST.

First obtain a piece of No. 6 B. & S. gage copper wire and cut it to the size desired. A binding post and a thin piece of



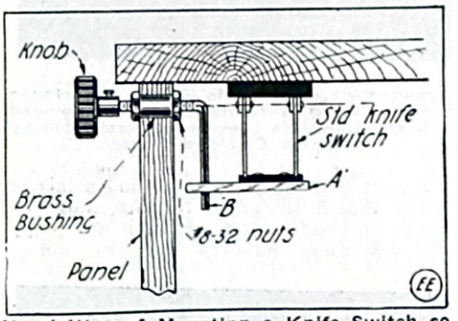
A Tuning Coil Slider That Can Be Clamped in any Position—Made from a Binding Post.

brass are then procured, bending the brass to the shape shown in the illustration and soldering it to the base of the binding post. The rod is slipt thru the binding post and the end fastened to the coil heads. Those having square rods may use this stunt by filing out the hole in the post until it is square.

Contributed by JASPER TELFORD.

USING KNIFE SWITCHES IN RADIO CABINET SETS.

This is a good way to mount a change-over switch or any kind of a switch in a



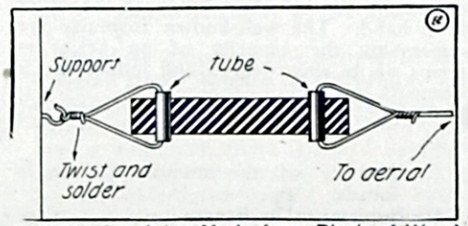
Novel Way of Mounting a Knife Switch so as to Be Controlled by a Rotary Knob on a Cabinet Set.

cabinet set where the porcelain would not look well. Screw the switch on the under side of the top of your cabinet. Take off the handle and screw on a piece of hard wood or fiber A, allowing one end to project a little way. Bore a hole in this end. Then drill a hole in the front of the cabinet exactly in line with the blade pivot screws. Put a rod, B, thru this, bent as shown. One end goes thru the hole in the piece of hard wood or fiber. A switch knob is put on the other end.

Contributed by
GEORGE NICHOLS, JR.

SIMPLE AERIAL INSULATOR.

The accompanying sketch is that of an insulator for amateur aerials that has given me satisfaction for over a year. It con-



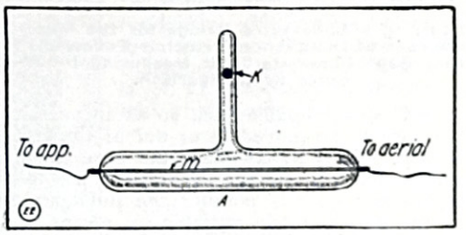
Antenna Insulator Made from Block of Wood Thru Which Two Porcelain Tubes Pass.

sists of a block of wood "A," drilled to fit a porcelain tube "B," such as those used in wiring houses. The tube is broken in the center and one piece is inserted in each hole. The wire to the support is fastened thru one tube and the aerial thru the other. Porcelain tubes may be snapt off by striking them sharply against a brick or other sharp-cornered body. A good method is to grind a groove around the point of desired rupture by means of a high speed emery wheel. The tube can usually be then snapt in half by a sudden blow as above described.

Contributed by NAT SHEPARD.

A PRACTICAL RADIATION METER.

When installing and testing a transmitting helix and an adjustable condenser, a radiation meter is a necessity. This simple piece of apparatus consists of a glass tube, A, about five inches long, with a fine plati-



Simple Hot-wire Ammeter in Which the Heat Causes a Drop of Alcohol "K," to Rise Within the Capillary Tube.

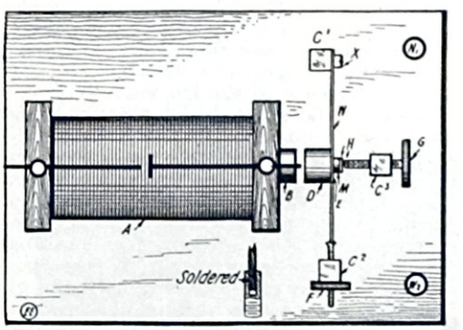
num wire, M, extending its entire length. A small bore capillary tube, K, which contains a drop of alcohol, is blown in on one side. This tester is connected between the antenna and the transmitting instruments. When the current passes through the platinum wire it heats and expands, slightly compressing the air, forcing the drop of alcohol upward. By changing the number of condenser plates, and the turns of the helix until the drop is at its most distant point, the greatest radiation and best adjustment are made known.

Contributed by OTTO WHITELOCK.

HIGH FREQUENCY VIBRATOR FOR INDUCTION COILS.

The vibrator shown in the accompanying sketch can be easily constructed and attached to any coil. It is suitable for small spark or medical coils, and greatly improves the note of the spark when used for wireless.

In Fig. 1, A is the body of the spark coil, B is the core, C_1 and C_2 are two square



A High Speed of Interruption May Be Attained With This Break as Both Ends of the Spring Are Fastened.

brass standards, W is a thin strip of spring brass or phosphor bronze attached to the standard C_1 by the screw X; to its opposite end is soldered the tension srew, F.

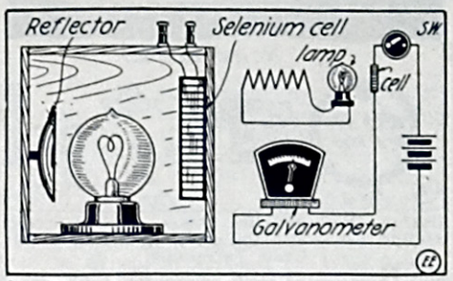
At the center of the strip W and opposite the core B, a short piece of soft iron rod D is attached by the screw M, and to the head of this screw is soldered a small piece of platinum or silver H.

C_3 is the standard supporting the contact screw G—the old one from the coil may be utilized or a new one constructed. N_1 and W_2 are the terminals.

Contributed by R. L. DUDGEON.

A SELENIUM CELL RADIATION AMMETER.

The illustration indicates a radiation meter that can be used on radio transmitting sets, ranging from a one inch coil to a one kilowatt transformer. Usually only an expensive meter will register on a one inch coil. This scheme comprises a pilot lamp placed in a darkened box, together with a selenium cell as shown in the illustration. The coil of wire is placed near the oscillation transformer. When the transformer is operated the pilot lamp lights up and lowers the resistance of the selenium cell, allowing some of the bat-



In This Selenium Cell Radiation Meter, Varying Intensities of Light Are Caused to Affect the Resistance of the Selenium-Galvanometer Circuit.

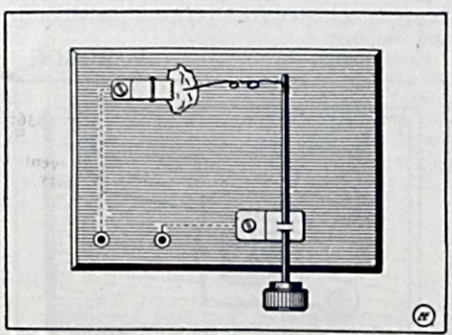
tery current to pass thru. This registers on the galvanometer. The pilot lamp may be put in series with the aerial. The brighter the lamp glows, the higher the deflection on the galvanometer.

Contributed by FRANK WALCUTT.

EASILY MADE, SPRING CLIP DETECTOR STAND.

First make a wood base 3 x 4 inches of some hard wood and cover with two coats of orange shellac. Mount two binding posts at one end of the base. The "cup" of the detector is made from a brass helix or testing clip flattened out and a hole bored close to clip. This is fastened to base with battery bolt and a washer next to the wood to permit turning easily. The arm comprises a brass pin about 2½ inches long, a brass spring binding post, electrite cap nut and a cat-whisker. First solder pin to cap nut and slide thru spring binding post. Next solder cat-whisker to other end of pin. This is also fastened to base with battery bolt and a washer. The cup is connected to one binding post and the arm to the other. By moving both cup and arm any part of mineral may be reached.

Contributed by WILTON M. SMITH.

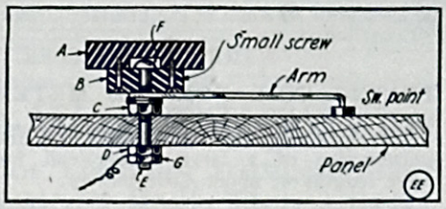


A Detector that Is Simplicity Itself—Comprising a Chunk of Galena in a Test Clip and a Cat-Whisker Contact Held in a Spring Binding Post.

A NOVEL "TAP" SWITCH OF NEAT APPEARANCE.

The stumbling block for many amateurs when constructing a Navy type coupler or a cabinet tuner is the *tap switch*. Following is a description of a novel tap switch with which the writer has had excellent results.

The knob is made of two pieces of hard rubber, ⅜ inch thick, as shown at A and B. A hole 1/32 inch larger than the diameter of the machine screw E, is drilled thru the latter and a ¼ inch hole, ¼ inch deep, is drilled in A from the under side, to accommodate F. The screw E is now in-



Efficient Tap Switch Construction Giving Thoro Insulation at the Knob.

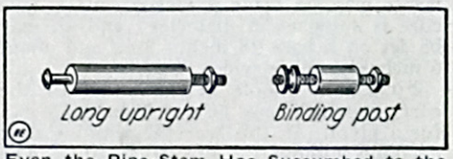
serted in the hole drilled thru B. The latter is fastened to A by means of two, or better three, small wood screws which also hold the blade as shown. E is secured to the panel by means of the lock nuts C and D, which hold it firmly. Another nut G, can be used to hold the connecting wire if solder is not desirable. The great advantage of this type of tap switch over the ordinary kind is that the shaft is stationary and the knob only rotates; therefore the machine screw can be permanently fastened to the panel. This eliminates the experimenter's greatest bug-a-boo in rotary switch construction—loose switch leads.

Contributed by I. J. AMARDIEL, JR.

[*Large switches of this type may be improved by placing a small spiral spring under the head of the machine screw with suitable washers, etc., to press the blade and knob against the washer C.*—ED.]

GOOD BYE TO FATHER'S "JIMMY" PIPE!

Here at last we have a use for stems of



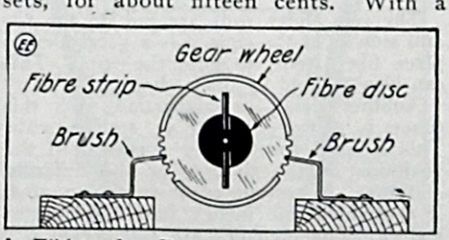
Even the Pipe-Stem Has Succumbed to the Radio Amateur—What Next?

old "jimmy" pipes that have seen better days. First cut off the mouthpiece from the stem and pass a machine screw thru it. This makes a serviceable upright. Shorter binding posts can be made by cutting off sections of the stems, passing a machine screw thru it and adding two nuts as shown.

Contributed by
NATHAN W. WOLPERT.

AN UNDAMPED WAVE TIKKER.

Oftentimes amateurs have trouble in bringing in the high powered undamped wave radio stations. Here is a tikker which I have tried out and found to work very well. At a hardware or sporting goods store you can procure a gear wheel, such as is used in Meccano sets, for about fifteen cents. With a



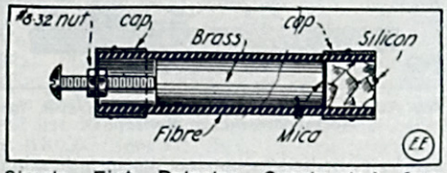
A Tikker for Receiving Undamped Wave Signals, Made from a Small Gear Wheel Mounted on a Battery Motor and Two Brushes.

large drill bore out the center of the wheel and insert a piece of fibre or some good insulating material that will fit tightly. This is then fastened to the wheel by screwing a thin piece of fibre to the insulating material and the wheel on both sides. A hole is drilled in the insulating material to fit the shaft of a small motor. The make and break brushes are made by screwing to the base (or whatever the motor is to be placed upon), two thin pieces of brass. These are then bent so that when the motor is started there will be an intermittent interruption of the current.

Contributed by
EUGENE CAWLEY.

A PERMANENT DETECTOR OF THE TELEFUNKEN TYPE.

Procure a burned out 30-ampere cartridge fuse, remove the cap and clean out thoroughly. Drill a 3/16" hole in the center



Simple Fixt Detector Constructed from Cartridge Fuse with a Brass Plug Arranged to Press Against Several Pieces of Silicon.

of the end of the removed cap. On the inside of this cap or cup, solder an 8/32 nut. Next drop a few small pieces of silicon into the fiber tube so that they touch the metallic bottom of the other cap.

Cut out of thin mica a round disc the same diameter as the hole in the fiber tube. Lay this flat on the silicon. Cut a piece of brass rod of the same diameter as the mica disc and 1 inch long. Put this inside the tube, replace and fasten cap screw (a 1-inch 8/32, round head brass screw with lock nut) into replaced cap and detector is completed.

To adjust, connect up in the usual way, tighten set screw until signals can be heard and then set where the signals come in the loudest. Two or three of these detectors can be kept handy at all times.

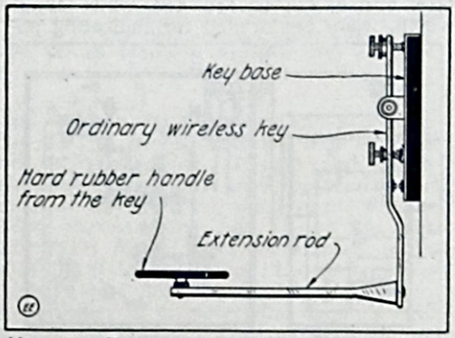
This detector can, like a fuse, be slipped into a cartridge fuse block, making it very professional-like in appearance.

This detector works by allowing a sharp point of the silicon to pierce thru the mica disc, thus contacting with the brass piece.

Contributed by E. L. KENNEY.

PANEL WIRELESS KEY.

The illustration shows a wireless key altered so as to be of suitable design for panel radio sets. The only new part is a



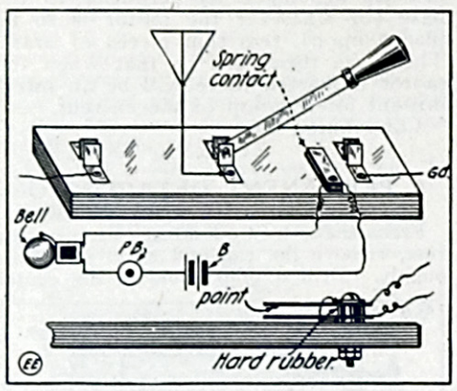
How the Transmitting Key May Be Effectually Mounted in Cabinet Style Radio Sets.

brass or fiber extension rod. This is filed down and threaded at one end to fit into the hole which formerly contained the rubber knob. Then it is up-set (riveted) or secured with a nut to hold it securely. A hole is bored in the other end to hold the key-knob which is held in by the tight fit caused by the threads.

Contributed by H. R. HOSBACH.

A SAFETY IDEA FOR LIGHTING SWITCHES.

Many times it happens that the lightning switch is not thrown to the ground position, endangering the apparatus and building in which they are located. Forgetfulness is the cause of neglect in many cases. This



An Auxiliary Tell-tale Indicator Circuit for Aerial Grounding Switches.

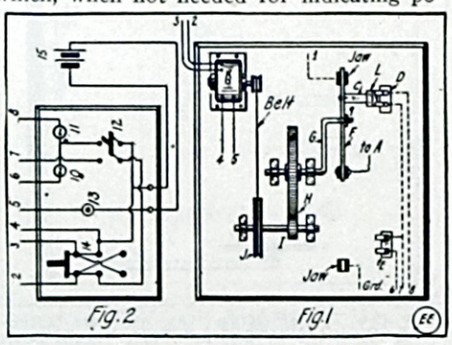
can be remedied by connecting an indicating instrument such as a bell or lamp with the ground switch as shown in the diagram. To ascertain if the switch is thrown properly all that is necessary is to push the button; if grounded, the bell will ring.

Contributed by JOHN B. RUKOSKI.

A LIGHTNING SWITCH WITH REMOTE CONTROL.

I describe below a remote control lightning switch. A is aerial, Grd., is the ground, C a piece of fiber or wood 2" long and ½" square, with a small piece of brass L, which connects two contact pieces on fiber block D thereby lighting the white battery lamp at 11, Fig. 2. Also, when switch is grounded it connects contacts at E, Fig. 1, lighting red lamp at 10, Fig. 2. F is a switch blade; G is an arm connected to the blade at 9 and forms part of shaft for gear H, which meshes with pinion I on the same shaft with wooden pulley J, operated by a belt from the small battery motor at K. Gear H should be about 2" in diameter, gear I about ¼" and the wooden pulley 2".

The switch should be protected from weather by a box placed over it on the aerial mast or on the building. In Fig. 1, wire No. 1 is the lead in, Nos. 2 and 3 are the field wires of motor leading to reversing switch 14 in Fig. 2. Wires Nos. 4 and 5 are the armature wires leading to the battery 15, with a push button 13, cut in on the wire as per diagram. Wires Nos. 6, 7 and 8 run to red and white lamps which, when not needed for indicating po-



A Remote Control Antenna Switch, Equipt with Tell-tale Lamps and Motor for Throwing the Switch Blade Over.

sition of the switch, are cut off by switch at 12.

OPERATION:—Close switch 12, which in this case lights the white lamp at 11. Throw reversing switch at 14 down and push button 13 until the red light is lighted, then release push button. Open switch at 14 and then 12 and you are ready for the next thunder-storm.

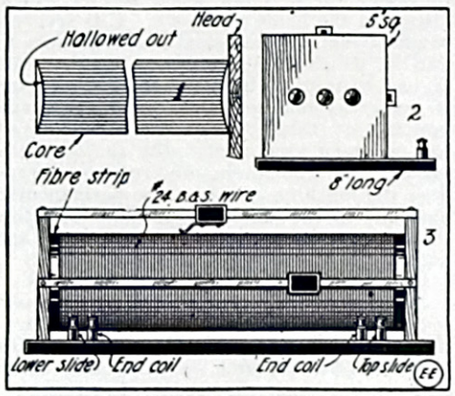
The motor I have in use is a "Standard" four-volt machine, and the lamps are of the six-volt carbon type. The battery consists of four dry cells, or if the house current is at hand a small transformer may be used with a switch in the primary circuit.

Contributed by HERBERT W. FRYER.

TUNING COIL FOR 1,000 METER WAVE LENGTHS.

The following are the details for the construction of a large tuning coil for wave lengths of about 1,000 meters:

Obtain a wooden core, as it is much more solid than the usual cardboard tube. It may be turned from a piece of wood 17 inches long by 5 inches square. Hollow out the ends slightly, as this makes the

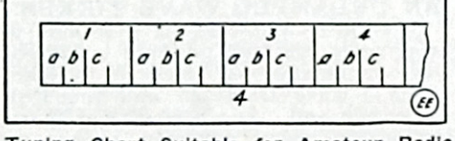


Improved Design of Tuning Coil for 1000 Meters Wave Length.

heads of the coil fit tightly (Fig. 1). The heads may be made 5 inches square (the core is 4 inches in diameter) and all may be set on a base 18 inches long and about 5 inches or more wide.

First bore a hole in the center of the core, in which may be put a finishing nail for a pivot. In this way the winding may be done without the use of a lathe. The coil may be wound by turning the cylinder in the frame with the left hand and guiding the wire on with the right.

Station	Position	Coil	Top slide	Lower slide
Mare Island	Vallejo	N.P.H	7·A	9·B
San Francisco	N S E	K.P.H	12·B	9·A
John Supow	Sacramento	W.C.A.	11·A	11·B



Tuning Chart Suitable for Amateur Radio Stations.

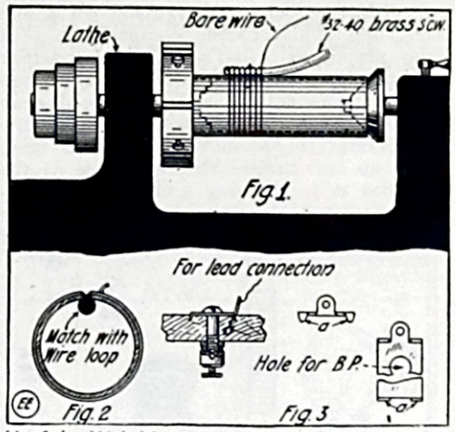
The two slider rods are put on the top and side. On the ends it is a good idea to place fiber strips to hold the wire. This can also be held by brass shoe tacks.

Another detail in connection with this tuner is a wave length or station scale. This is used for keeping a record of the positions of the sliders for the different stations. A section of it is shown at 4. It is divided into inches, half and quarter inches. The quarters are numbered a, b and c, while the inch marks carry numerals, 1, 2, 3, etc. A pointer should be placed on the slider, of course, to co-act with the scale. Thus the station calls may be charted as shown at 5.

Contributed by LE ROY D. BROWN.

TUNING COIL HINTS.

Many amateurs have no doubt found it very hard to wind bare wire tuners or loose couplers. The ratio used by many reputable concerns for loose couplers is 32 wires per inch for the primary and 40



Useful Wrinkles for Those Constructing Tuning Coils and Couplers, Including Metal Lead Terminals.

wires per inch for the secondary. The size of wire used is optional; any catalogue will give you the proper ratio. Thread a brass rod with a 32-thread die. As the 40-thread die is very small it would be well to turn threads on the rod with a lathe. The illustration (Fig. 1) explains how this is worked. Any suitable winding device may be used. A coat of orange shellac will hold the wire in place.

If, when winding a silk-covered wire secondary, you do not like to stop to put on a lead where the hole is in the cylinder, insert a loop of wire through it and put the end of a match through the loop (Fig. 2). The leads may be soldered at leisure.

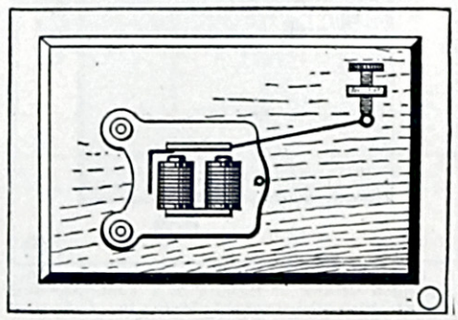
A good method in connecting leads to binding posts, contacts, etc., is to take a piece of copper or brass and cut it as in Fig. 3. The sharp-pointed nibs (a) help to secure this contact plate to wood surfaces, so that the binding post may be removed without the lead being lost. It is widely used where a great number of leads are bunched or grouped together.

Contributed by K. TOWNSEND.

IMPROVED TEST BUZZERS.

Mount an ordinary bell, minus the gong, upon a wooden base. Opposite the clapper fasten a small block of wood with an adjusting screw in it. Adjust this screw against the clapper until a shrill note is obtained. This method is much superior to prying a match stick between the vibrator and hammer.

Contributed by I. ROSIN.



Simple Way of Making a Hy-note Test Buzzer. An Adjusting Screw Before the Clapper Does the Trick.

If you are using some new wrinkle or attachment in your station, why not write it up and send it to the editor? All articles accepted and published are paid for at regular rates. Manuscripts should preferably be typewritten. Pencil sketches sufficient.

THE CONSTRUCTOR

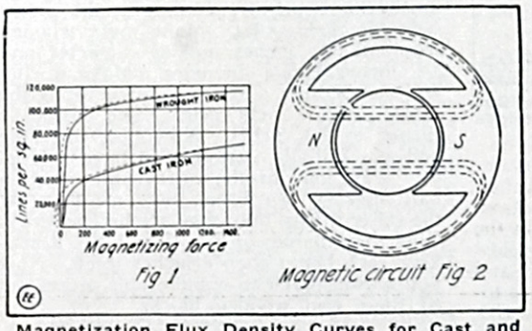
Building a 500-Watt Direct Current Dynamo

This Dynamo Is Suitable for Lighting Lamps, Charging Storage Batteries and Exciting Radio Transmitters

By GEORGE STURLEY

IT is the purpose of this article to show both theoretically and practically something of the design and construction of small dynamos. I have taken a half kilowatt (500 watt or .67 H.P.) dynamo for an example. (One horse-power=746 watts: 1 kilowatt=1000 watts).

Suppose we desire a 50 volt dynamo that is to be driven at a speed of 1,800 r.p.m. and which is to have a capacity of one-half kilowatt. That is all we know to start with. There would be several sizes of machines that would give one-half kilowatt, but at first we assumed a speed of 1,800 r.p.m., so now we are limited by the strength of magnetic field we employ and the number of turns of wire on the armature. From an every-day knowledge of dynamos we can obtain a fair idea of the size of armature core we need. Let us try one 4 inches in diameter and 4 inches long; that will make an armature cross-section of 16 sq. in. Assuming that we have 40,000 magnetic lines of force (flux) per square inch, this yields a total flux of 640,000 lines thru the core. From the permeability curve (Fig. 1) it is evident that 40,000 lines of flux



Magnetization Flux Density Curves for Cast and Wrought Iron, and Diagram Showing Path of Flux in Bipolar Dynamo.

per square inch is a reasonable value. It is best to choose a low value because it requires less energy thru the field winding to produce it. Now we can calculate how many armature turns will be required with this assumed flux to generate our 50 volts. We will compute this by the formula:

$$Volts = \frac{\phi \times N \times Z \times P \times K}{10^8 \times P^1}$$

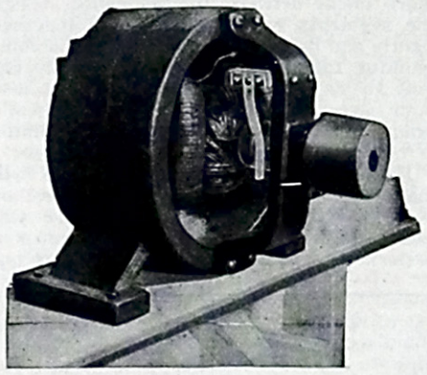
Where:

ϕ = flux thru armature
N = speed per second of armature
Z = No. armature inductors
P = No. of poles
P^1 = No. of paths thru the armature
K = factor pole pitch.

In the above formula the factor K, appearing above the line, may be explained as follows: The ratio of the arc subtended by the field poles, to the arc on the circumference of the armature is considerably less than unity and in a machine of this type the factor is taken as about .75. Substituting the proper values in the above equation we have:

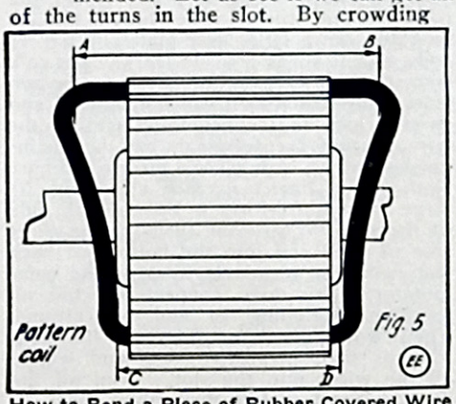
(The Voltage) $50 = \frac{640{,}000 \times 30 \times Z \times 2 \times .75}{100{,}000{,}000 \times 2}$

$50 = \frac{3.6Z}{25}$ $Z = 348$



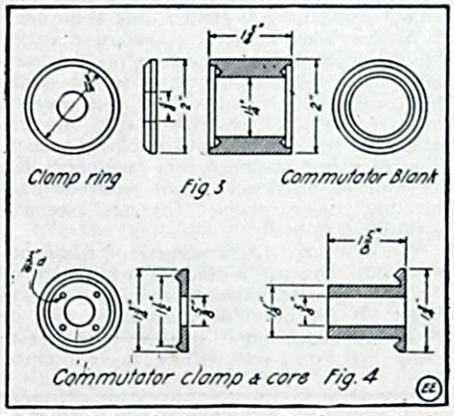
Appearance of Finished 500-Watt D.C. and A.C. Dynamo as Built with Successful Results by the Author

As 348 does not divide up evenly, we will select 360 inductors instead. Every turn on the armature goes thru two slots, so each turn constitutes 2 inductors. If we require 360 inductors we will need 180 turns on the core to generate 50 volts. Let us use armature discs with 18 slots, say ½ inch in diameter. That will make 18 coils with 10 turns per coil. If we desire one-half kilowatt, our dynamo must carry 10 amperes or better thru the *two paths* of the armature. Each path carries half, or approximately 5 amperes. Allowing 500 circular mils cross-sectional area per ampere, our armature conductors will have to be at least of 2,500 cir. mils or No. 16 or No. 15 wire. For armature windings double cotton covered wire is recommended. Let us see if we can get all of the turns in the slot. By crowding



How to Bend a Piece of Rubber Covered Wire to the Form of an Armature Coil for a Pattern, from Which to Make the Other Coils.

slot full of short lengths of the wire we get 30 in. Take two-thirds of 30 for the proper number to fill the slot, or 20. As our 180 turns make 360 entries of the slots or 20 per slot, our ½ inch slots will do. We will do very well to decide on a bi polar (two-pole) field. A ring type of yoke for the magnets is of better appearance and lighter than other styles, so we will use it. As the field magnet must carry 640,000 lines of flux, its cross-section should equal that of the armature. So our field magnets will be 4 inches square. It is general practise to let the field magnets enclose seven-tenths of the circumference of the armature, so with our 4 inch square poles, a space between poles of about 2¼ inches is all right. The field ring forms two paths for the flux (Fig. 2); we will permit the cross-section of the ring to be 8 inches wide and 1⅜ inches thick (area = 11 sq. in.). Now we have to determine how many *ampere-turns* will excite this magnet. We figured on needing 640,000 lines, but allowing for magnetic leakage we must figure on 750,000 lines. All this flux, we figure, has to pass thru the armature, and consequently thru the two air-

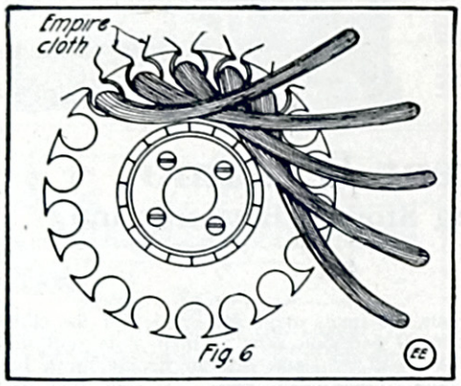


Details of the Commutator Shell and Blank from Which Segments Are Cut with a Hack-Saw.

gaps between field magnets and armature. The air-gap in our machine will be 1/32 inch on each side, or 1/16 inch total. With our 750,000 gross flux lines the density per sq. in. is 34,000. By looking at the permeability curve again (Fig. 1) we see that for 34,000 lines, about 24 ampere turns (A.T.) will force the flux thru the ring for a length of 1 inch. Assuming the ring to be 11 inches in diameter, the distance half way round is about 17.25 inches. So 24 times 17.25 will make 415 ampere-turns for each side. Two sides make 830 A.T. For an air gap 1 cm. long about 6,000 A.T. would be required to force our flux across, but as our gap is only .16 cm., 975 A.T. will do it. We will allow 720 A.T. for the circuit thru the magnet cores and the armature core. Summing up: 975+830+720 = 2,525 A.T

As we have a 50 volt current to deal with, we may proceed to design a shunt field.

winding, or one that may be connected directly across the brushes. If we wind each coil with No. 21 S.C.C. magnet wire, very close to 2,500 turns per coil can be wound and the resistance of the whole field should



Showing How the Form-wound Armature Coils Are Laid in the Slots, Each Coil Overlapping Its Neighbor. The Coils Are Placed in the Slots a Few Turns at a Time, Until All Are in Place.

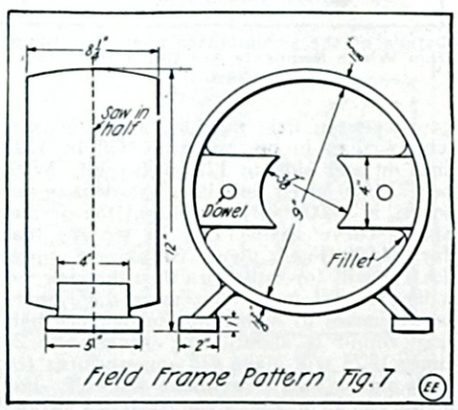
approximate 100 ohms. This will give a field current near ½ ampere and will magnetize it.

A small field rheostat should be included in the field circuit to raise and lower the voltage as desired.

Possibly we could have designed this dynamo for higher speed and then it could have been smaller. But high speed is very undesirable as the bearings wear faster and sparking and vibration are more severe. If we had used a 3 inch armature a very high speed would have been necessary to obtain our output. And if we had used a 5 inch core, the cost would have been unnecessarily high. Of course if a low speed like 1,200 r.p.m. were required, a large machine would have been the only solution.

In this machine it is proposed that the builder make his own pattern for the castings. The field casting here described has been computed for cast iron, but may be of cast steel; if cast iron is used, the capacity of the dynamo will not be as much. The cast iron cannot carry magnetic flux as well as soft steel (for reduced magnetizing power required for steel, see any dynamo text-book).

We will build the armature of the dynamo first. Procure a stack 4 inches high of 4 inch diameter armature discs with 18 slots. If the hole for shaft is ⅝ inch or better all right, but if smaller, it is best to ream the holes out with a taper reamer.

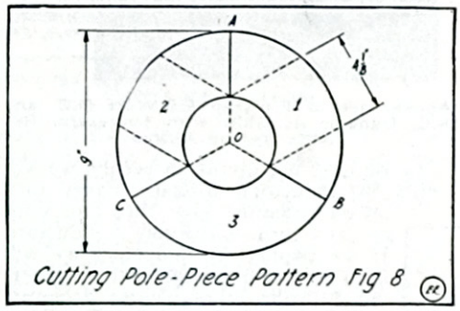


Wood Pattern for Dynamo Field Magnet Frame.

The shaft is made from a piece of cold rolled steel ⅝ inch in diameter and 17 inches long. Center this at each end in the lathe. Turn out two brass or iron clamp washers according to Fig. 3. Braze or sweat one on the shaft 6 inches from one end. Put on the discs so that the slots line up. Then put on the other clamp washer and screw the core tightly together in a vise and sweat the washer on. That finishes the core.

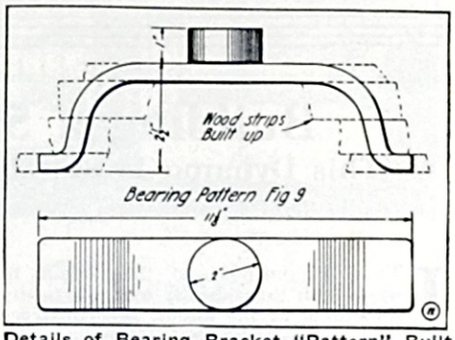
If the builder has no commutator and prefers to make it, that can be done as follows: Turn a brass or copper blank (Fig. 4) and saw the segments with a hacksaw. File off all raw edges. Then cut up a stack of sheet mica resembling the cross-section of the segments. See Fig. 3. They do not have to be cut exactly, as the commutator is turned down when all assembled. A stack about ½ inch high will be needed. Turn out a brass or iron core and a clamp ring. See Fig. 4. This core is insulated with mica. The clamp-edges of the core and ring are insulated by mica washers. Assemble the segments on the core with their mica insulators. Put a rubber band around it temporarily. Use plenty of shellac. If the core seems too large, put in more micas between the segments. When the segments fit, bolt the whole together tightly and bake in an oven. Putting a commutator together is tedious and annoying and so do not be surprised if you lose your sweet disposition momentarily while doing it. After baking, the commutator is turned down smoothly.

How to wind the armature. We will make form-wound coils. With a piece of No. 14 rubber covered copper wire you can form a single turn on the core as a pattern of a coil. This pattern coil is put



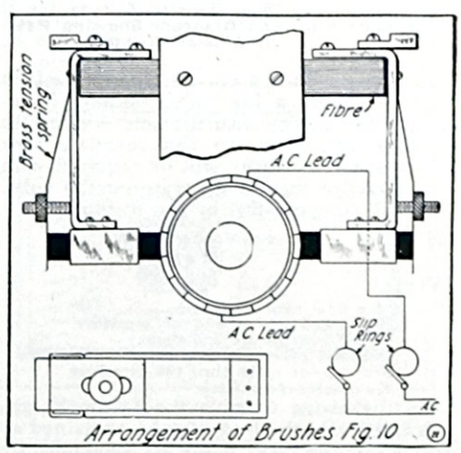
The Field Magnet Cores (Pattern) Are Cut from a Wooden Ring of the Dimensions Shown Above.

thru diametrically opposite slots (Fig. 5) and one side is made to occupy the bottom of one slot while the opposite side is in the top of a slot, and is made longer to allow coils under it to pass. Measure AB and CD. Take the pattern out and measure total length. Subtract the sum of AB+CD, which leaves the length of the sides. Now you can drive four pegs in a board with the above distances between pegs. Wind the coils on this form. The board can be mounted on a lathe face-plate. Wind 18 coils with 10 turns (No. 16 D.C.C.) per coil. Before taking each coil off the form, tie two sides with string so it can not unwind and twist a loop in the beginning end of the wire so that the terminals can be distinguished later. Now place a piece of Empire cloth (oiled linen) in each slot (Fig. 6) large enough to form a lip on each side of the slot. Wiggle the turns of the short side of each coil into the bottom of each slot, with the terminals towards the commutator. This done, connect the coils all together, beginning to end, all around. Then work the long sides of the coils towards their respective slots and wiggle all the wires into the slot. Trim off the surplus Empire cloth to within about ¼ inch from the core. Tuck these edges in the slots. Then a fibre wedge can be driven in each slot closing it. Paint the winding well with insulating varnish and bake it dry. Then solder the leads to the commutator bars. Each end-lead of a coil goes to a bar 90° distant from the slot for the brush arrangement here shown; if the brushes are in line with the space between the field poles, then the coil leads are brought over straight to the commutator. The armature may be tested for grounds or shorts. Better do that for the commutator before soldering any leads on.



Details of Bearing Bracket "Pattern" Built up from Successive Strips of Wood Glued Together. This Is Used to Make the Casting With.

The next thing is to get the field casting made. First, a pattern of the field magnet must be made of wood suitable for the foundry. Cedar or white pine well seasoned may be used. The field ring will be the first part of the pattern to make. Make a paper segment ⅓ of a circle 12¼ inches outside diameter and 8¾ inches inside diameter. With this pattern mark and cut a stack of wooden segments to make up a hollow ring 8½ inches high. Join the radial edges up neatly with a plane and glue the whole stack together on a wooden board bolted to your lathe face-plate. When the glue is dry turn it down smoothly till it measures 11⅞ inches at the edges and 9 inches at the center. Turn the outside of the ring till the wall is a little over 1 inch at the edges and nearly 1⅜ inches at the center. Knock off the face-plate board and finish the remaining edge with the plane. Now the field poles. Make more wooden segments 9½ inches outside diameter and 3½ inches inside diameter. Make a ring 4¼ inches high. Turn it down to fit the inside of the field ring. The inside is turned to 3⅞ inches. Now take this ring and saw radially, cutting it in thirds. (Fig. 8.) Take one of the thirds and rip it in half, making two pieces the same shape as the other thirds, only they are half as thick. Glue these halves on No. 1 and No. 2, making each better than 4 inches thick. Now you may proceed to cut the pole pieces out of these two wooden blocks.



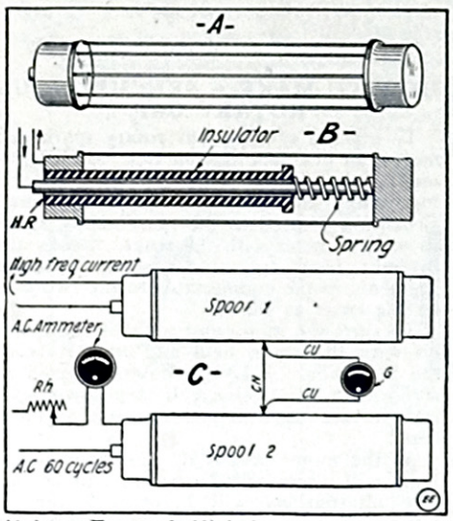
Arrangement of Brush Gear and Connection of Slip Rings to Commutator when A.C. Is Desired.

This idea makes your pattern with minimum waste. Economy may be worth while

(Continued on page 932)

A Novel High-frequency Ammeter

A VERY interesting type of high-frequency ammeter is described by E. F. Northrup and R. G. Thomson in the journal of the *Franklin Institute*. The various parts of the instrument are shown schematically in the illustration. On a cylindrical frame there are twelve No. 38 Manganin wires supported as shown at A. The length of the wires between the brass-end rings of the spool is 3½". Care should be taken to solder the wires in such a manner that each one has exactly the same length and resistance. The wires are maintained taut by means of a spring as seen at B. Current is led in to one end of the set of wires along the axis of the cylinder. Two of these cylinders are made exactly alike. One of these cylinders, which is called the spool, carries the high-frequency current, while the other carries the comparison current. When the currents thru each of the spools have the same effective value, the heating effect of the current of each spool is the same, not only for the spool as a whole, but for each individual wire.



Unique Type of High-frequency Ammeter which Operates on the Comparison Principle; the 60 Cycle A.C. Is Varied Until Zero Deflection Is Obtained on Galvanometer G, when the Heating Effect in Spools 1 and 2 Is Equal.

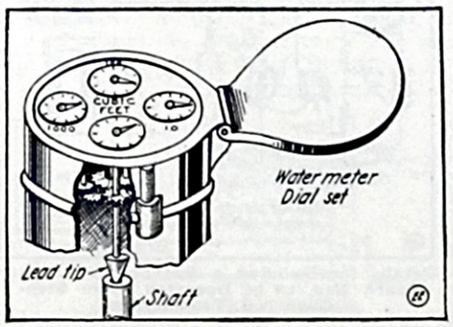
By connecting together near the middle point one wire of each spool with a piece of very fine Constantan wire, CN (see Fig. C), and also by fastening the points of juncture with fine copper wires, a thermo couple is produced which is connected to a sensitive galvanometer. This gives a very delicate indicator of the condition that the two spools are carrying currents having equal heating effects.

The procedure in measuring the high-frequency current consists in passing this current thru spool No. 1 (Fig. C), and 60 cycle alternating current in series thru an ammeter, an adjustable rheostat and spool No. 2. Then vary this latter current until the galvanometer attached to the thermo couple gives no deflection. When this adjustment is made both junctions of the thermo couple are at the same temperature, and assuming the spools to be identical and under like conditions in respect to loss of heat, the effective values of the high-frequency current and the low-frequency comparison are the same. Sixty cycle alternating current is used instead of direct as a comparison current, for the reason that when direct currents are used, some of this current finds its way thru the galvanometer with the best attachments of the thermo couple junctions to the wires which it is practical to make. This difficulty is avoided by the use of the alternating current.

While it is impossible to make two spools which are in all respects identical and which lose their heat at the same rate, the lack of symmetry was provided for and made to have no influence by shunting the spool of higher resistance until, on the passage of equal measured currents of low frequency thru each spool, the galvanometer deflection was reduced to zero. In using the meter for measuring the high-frequency current, the low-frequency current was past thru the shunted spool, because a low-frequency current will divide between the wires of the spool and the shunt, according to Ohm's Law, while the high-frequency current will not so divide. To insure uniformity in its performance the meter was mounted in a tin box and immerst in paraffin oil. From all the experimental data obtained it was assumed that the error in measuring the effective value of the high-frequency current did not exceed 5%. An instrument of this kind will prove very useful in the experimental radio or electrical laboratory.

A SIMPLE SPEED INDICATOR.

The only material necessary to make this speed indicator is the integrating gear movement from an old water, gas or electric meter, which may usually be obtained from the city engineer or the water company for the asking; also, a piece of brass or lead of the shape shown in the drawing.



A Speed Indicator Can Be Readily Constructed from the Integrating Mechanism of a Water, Gas or Electric Meter.

The lead or brass piece should be turned in a lathe so as to have a conical shape. A small hole, a little smaller than the end of the shaft of the "unit dial" of the meter, should be drilled exactly in the center of the cone. The shaft and hole are then threaded and screwed together. The conical-shaped piece on the end of the shaft is to be prest into the center hole on the revolving shaft.

To use this indicator simply read the figures on the meter, place, the conical-shaped piece of lead against the end of the revolving shaft and hold it there for one minute by the watch, and then note the reading. The numerical difference between the two readings will be the "number of revolutions per minute" at which the shaft revolves.

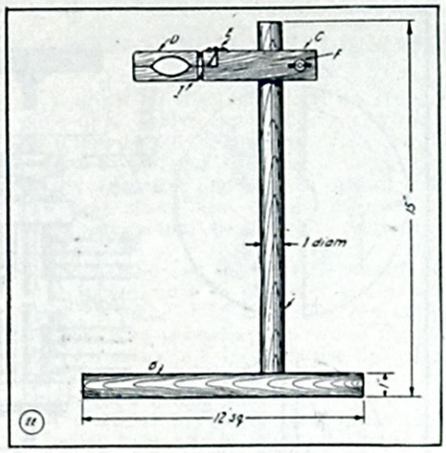
Contributed by FRANK SAHLMAN.

A STAND FOR AN X-RAY TUBE.

The stand described here was made for an X-Ray tube but will also be handy for various electrical and chemical experiments.

The stand consists of a baseboard B which carries a round stick, which in turn supports the holder C. This holder consists of two separate pieces, C and D, which are jointed together by the hinge E. A rubber band, I, holds C and D together and supports in this way the X-Ray Tube. (*It is preferable to drill a hole X and pass a machine screw, with wing nut, thru it.—Ed.*)

To fix the holder at a convenient height we have a bolt, F, which passes thru a hole in C and which carries a wing nut, G. A slot ⅛" wide is cut from the hole for the stick to the end of C and by tightening up the nut, G, we can camp C firmly against the upright and hold it securely in any position required. This stand is very easily made as the hinges, E, the washers, H, bolt, F, and wing nut, G, can be procured from any hardware store and the wooden parts should present no difficulties.



An X-Ray Tube Stand which Any Experimenter Can Make.

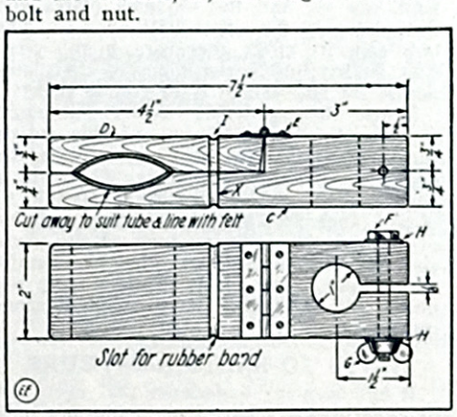
We start with the baseboard, B, which is 12" square and 1" thick. Plane a piece of wood to the dimensions given and drill a hole 1" dia. thru the center.

Procure a stick 1" diameter and 15" long and glue it into the baseboard. A glass rod may be used by those who want to make the best possible job of it, but a wooden stick will do all that is required for ordinary purposes. Next plane a piece of wood to the following dimensions: 7½" long, 2" wide by 1½" high. This gives us parts C and D. Cut a part 4½" long by ¾" high away and we have C.

A hole 1" diameter is now drilled thru C, 1½" from the end; also a slot ⅛" wide is cut from this hole to the end of the piece C.

We can now cut the shaded part out of C and D (to suit the tube) and line it with felt; also cut two small slots I, so that the rubber band cannot slip.

The hinge E is next attached to D and C and a hole for the bolt F is drilled about ½" from the end. The bolt F and wing nut G may be about ¼" 20 thread and the washers, H, are bought to suit the bolt and nut.



Details of X-Ray Tube Supporting Strip. May Be Made of Proper Size to Fit Any X-Ray Tube.

A stout rubber band, I, is slipt over the jaws C and D and the stand is completed.

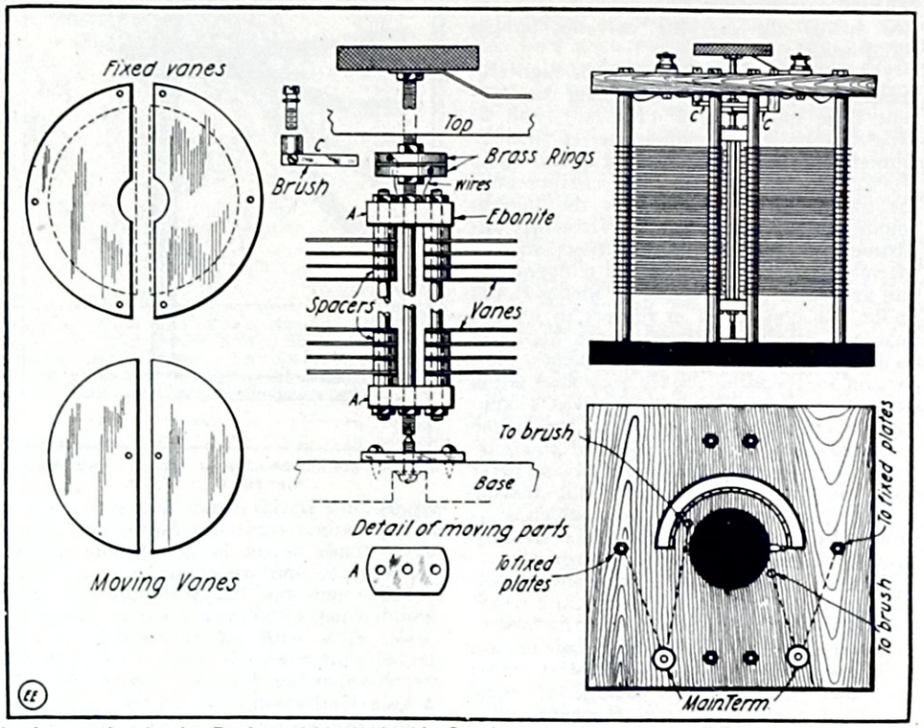
Contributed by C. A. OLDROYD.

DOUBLE CAPACITY ROTARY VARIABLE CONDENSER.

By G. Merton Bingham (Public Works Dep't., Gisborne, N.Z.).

In the sketch of this novel variable condenser no sizes are given as these may be left to the discretion of the maker.

Two sets of fixt plates and two sets of movable plates are required and these are cut and drilled as shown in the drawing. The supports for the moving plates may be ⅛-inch brass rods with ebonite (hard rubber) spacing supporters as shown at A. There is a pair of slip rings, each of which is connected to a set of movable plates. Thus the two sets of movable plates are not mutually in electrical connection, but connection is made to each of them by means of two brushes C.



An Innovation in the Design of Variable Air Condensers Whereby Twice the Capacity Is Obtained for a Given Volume, Compared to the Ordinary Type with which We Are Familiar. When Rotary and Fixt Plates of Like Sign Intermesh Then We Have Minimum Capacity In This Case, and Vice Versa.

Connections are also made to the two sets of fixt plates and the fixt and movable plates are connected to two main terminals as clearly indicated.

The action is as follows: When the plates are in zero position the movable plates and fixt plates in one half are of one sign, say +, and the movable plates and fixt plates in the other half are —. The only capacity effect, therefore, in this position, is that due to the edges of the plates across the gap, which is of course slight.

When the condenser shows maximum capacity, the fixt plates on one side are of the same sign as the moving plates in the opposite half and vice versa. Thus in a condenser of this design it is possible to obtain approximately *double* the capacity of one of the ordinary type of the same size. The sketch shows all other details which may be required. Rollers from ordinary bicycle chains make excellent spacing washers for the plates.

HINTS TO RADIO AMATEURS.

It has been my experience that every set of experiments I have ever made, not only proved an interesting pastime, but also added to the range of whatever radio station I happened to be working. This was particularly true in an old government station which had a working range of thirty miles on one kilowatt and could receive only fifty miles. The sending end was hopeless, I never transmitted more than seventy-five miles with it, but I did accomplish 1,400 miles with the receiving set; this being very good at that time, considering the outfit, which most amateurs even would be ashamed to own.

Many interesting and helpful experiments may be performed with a wave meter. Many more investigations can be made with the aid of a galvanometer and a Wheatstone bridge. Articles in THE ELECTRICAL EXPERIMENTER from time to time have given details of the above named apparatus in several forms, at a low cost.

Experiment with a piece of wire, say fifty feet long; measure its wave length straight, and wound in coils of various sizes. Measure the current received thru various gages of wire and compare the current received thru coils wound with bare wire and insulated wire, and try to find or measure the comparative loss due to dead ends. But before proceeding with these tests, see that your aerial is well insulated and that the resistance of the connections is reduced to almost zero by properly soldered joints. Record the results and you will have the information with which to build a loose coupler of the highest efficiency and you will know just why you get the best results with it.

Money can often be saved by intelligent investigation and at the same time better results can be obtained. Hard rubber is ordinarily a better insulator than wood which has been boiled in paraffin, but in a station situated near the ocean the sending condenser plates were insulated with hard rubber, which was coated with moisture the greater part of the time. This caused a brush discharge which finally burned several paths from plate to plate and partially short-circuited the condenser. In this instance paraffined wood or fiber would have given better results with much less expense.

It will be seen that experiments carried on in the proper way will benefit the experimenter in many ways. They furnish a source of interest and amusement; they aid in the efficient design of apparatus; in some cases the saving of money is effected; and the amateur can work out the answers to the many puzzling questions that crop up without outside assistance. Therefore I advise every owner of wireless apparatus to be not only an Amateur, but an Experimenter as well.

Contributed by

E. GREENWOOD FRACKER.

HOW TO MAKE A SYNCHRONOUS ROTARY GAP.

To make a synchronous rotary spark gap motor, an ordinary Knapp type "SS" dynamo-motor is fitted with two A.C. collecting rings as shown in the drawing. Brushes are fitted to the rear casting so as to make contact with the rings. Leads are brought from two diametrically opposite segments in the commutator to the two collecting rings as shown.

To start the motor put a rheostat in series with the shunt field and start it from the D.C. side. A 12-volt lamp is placed in series with the twelve volt step-down A.C. transformer used to run the gap as indicated.

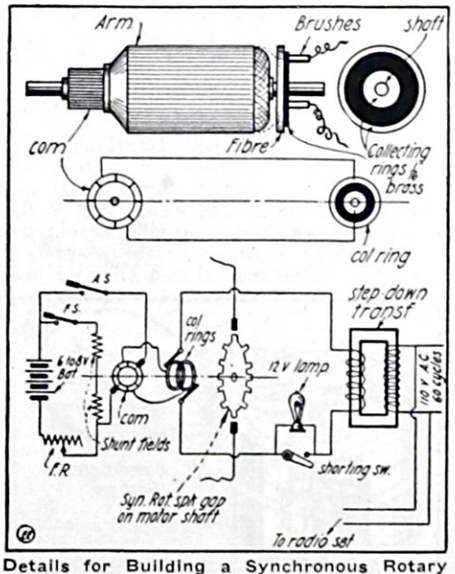
As the motor speeds up fast enough the lamp will alternately burn dim and bright. The alternations will become slower as synchronism is approached, and will finally be so slow as to permit closing the lamp shorting-switch as soon as the lamp dims. The armature circuit from the battery may then be opened; the field circuit being left closed.

In starting, if the motor does not run up to the right speed, so as to dim and light the lamp, adjust the field rheostat FR, until it does. This rheostat should have about 10 ohms resistance and be finely adjustable.

When the motor is running from the A.C. circuit it makes one revolution for every cycle, or 3,600 R.P.M. at 60 cycles. To get a 480 cycle tone use 8 points on disk; for a 6,000 cycle tone use 10 points.

Care should be taken to see that the rotary spark gap disc is thoroly insulated from the motor shaft or else there will be a tendency for a break-down between the armature winding and the shaft.

It was found that the radiation in the antenna was greatly increased when this gap was used instead of the old non-synchronous gap, and furthermore, the spark is always clear and steady. This gap has given very good results.



Details for Building a Synchronous Rotary Spark Gap, to be Operated From Step-down A.C. Transformer.

Contributed by

CLARENCE MUELLER.
(call—9EE.)

An Automatic Electric Phonograph Stop

By following the instructions below any experimenter can make a very good automatic electric stop for a Victrola or other talking machine. As indicated by the figure, D is an electro-magnet 2⅝ inches long and 1½ inches in diameter. An old motor field or an electro-magnet from an arc lamp or a large size electric bell is just the thing. One can be made by winding about 5 layers of No. 18 double cotton covered, magnet wire on a ½ inch carriage bolt, which has been properly annealed. This is fastened to the end piece L by means of a machine screw P, passing into the magnet core. The trigger B is made of a copper or brass strip ½ inch wide and about 3/32 of an inch thick. The pivot G consists of a piece of brass strip bent as shown in the illustration. The side X is soldered to the trigger B, about 2½ inches from the armature end. The sides Y and Z have holes drilled in them to permit a round head wood screw to pass through into the base of the instrument. A is a one inch round or square soft iron disc soldered on one end of the trigger. H is a piece of spring steel from an old clock with a piece of rubber tube R, slipt over it as shown.

E and F is the automatic circuit-breaker. It consists of two pieces of brass ribbon cut and bent as shown in Figs. 1 and 2. The electrical connections, given in Fig. 1, are made to the two binding posts J and K.

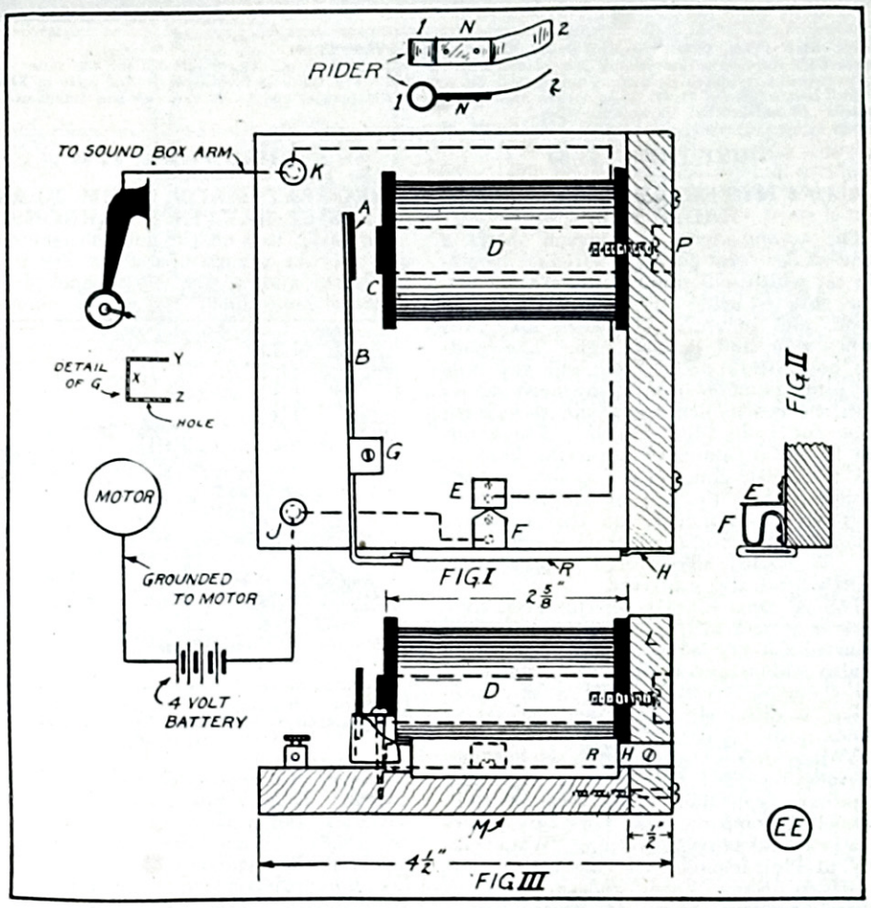
The instrument may be fastened to the phonograph by removing one of the screws which hold the motor board in place, and substituting the screw for one of the same kind but ½" longer, this extra half inch being used to pass thru the base of the automatic stop. The stop is placed so that when the spring H, is released from trigger B, it will bear with sufficient force on the revolving record table to arrest its rotation. When the spring is held in place by trigger, the two contacts, E and F, should make perfect electrical connection with each other. But when the spring is released, this connection should be broken, thus cutting off the current.

The rider N, is made of copper or brass bent as shown and having the hole 1, just large enough to make a snug fit over the screw at the center of the revolving table. A record is now placed on the machine, the rider just made is slipt over the screw, and the end 2 is bent so as to make contact with the sound-box arm just as, or a little after, the point where the phonograph ceases to play.

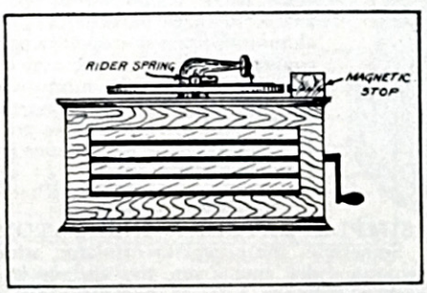
Everything being connected as shown in Fig. 1, the operation is as follows:

At the end of the record the rider N, comes in contact with the sound-box arm, thus closing the circuit of which magnet D is a part. The magnet, thus being energized, attracts armature A, which is fast to trigger B. Trigger B, in turn, releases spring H, which then flies off to the side, bearing on and stopping the revolving table. The spring H, on being released, allows the 2 contacts E and F to separate, thus breaking the circuit.

Contributed by
CHARLES HANAUER, JR.



Arrangement of Home-made Automatic Electric "Stop" on Disc Style Phonograph. The Electro-magnetic Brake Circuit is Closed by the Moving Sound Arm Making Contact with a Spring at the Center of the Record Table.



Front View of Automatic Electric "Stop" on Disc Style Phonograph.

A NEW ELECTRIC SOLDERING IRON.

A soldering iron operating on the principle of a welder can easily be constructed by following the description. The iron has several advantages over the old type, principally quickness and ease of operation and low first cost. The current is used only while the actual process of soldering is taking place.

The handle for the device consists of a fiber tube ¾ inch in diameter and 4 inches long. A piece of ¼ inch square brass rod 8 inches long is bent at one end as shown in the illustration. Two holes are drilled and tapt in one side of the rod so that it may be fastened to the handle.

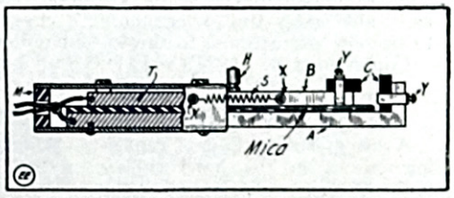
A piece of ¼ inch square brass tubing 3 inches long has two bolts soldered to it so it can also be bolted inside the fiber tube. A ¼ inch square brass rod 4 inches long, as shown at B, is next obtained, and small pieces of brass are soldered to it and the brass tube, to form hooks for the small spring shown at S. The rod B is also drilled and tapt to take shank of knob H.

Two small pieces of carbon are filed or cut ¾ inch long and ¼ inch square, as shown at C. Two clips are required to hold these carbon electrodes, and can be made from strips of brass ¼ inch wide and 1¼ inches long, bent as shown in detail with holes bored thru the overlapping ends. The clamping screw and nut must be assembled as shown, because it is impossible to solder them, due to the heat generated at these carbon blocks.

We are now ready to assemble the soldering iron. The flexible cord leading to the iron should be 6 or 8 feet long, and is first led thru the bushing M on the rear of the handle and a knot tied in it. The leads are soldered to the tube and rod before clamping them into place.

The rod B may be slid into position and the small springs slipt into place. A sheet of mica may be placed between the brass tube and rod to prevent short-circuiting. It only remains to clamp the carbon blocks into place to complete the assembly.

To use the iron slip the upright carbon back of the wires to be soldered and the other carbon pushed forward by knob H to clamp the wires between the blocks. The poor contact results in a comparatively large amount of heating of the wires to which the solder is applied with the free hand.



An Electric Soldering Iron that is Different. It is Convenient to Hold and when the Button "H" is Prest Forward the Joint is Clampt Between Two Carbon Blocks "C". The High Resistance Contact Results in Heating and the Solder is Applied in the Usual Way.

A suitable resistance will have to be used in series with this electric iron, preferably a water rheostat or lamp bank to keep the input down to 5 amperes. The handle should be covered with insulating tape to prevent short-circuits.

Contributed by THOS. W. BENSON.

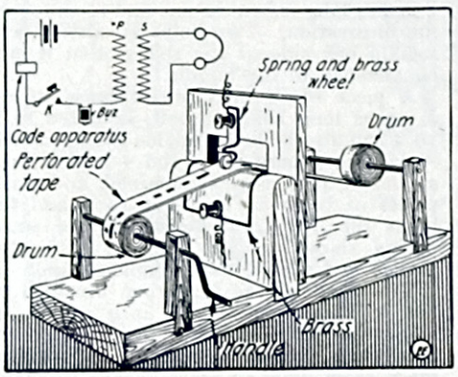
HOW TO MAKE IT

This department will award the following monthly prizes: **First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.**
The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of **$3.00** is awarded; for the second best idea a **$2.00** prize, and for the third best a prize of **$1.00.** The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

SECOND PRIZE, $2.00

A PERFORATED TAPE CODE TEACHER FOR STUDENTS.

Most of the articles that appear in this department are intended for amateurs who can receive, and this contribution is given for those who cannot read the code. He



A Perforated Paper Tape Passing Between Two Brass Contacts Opens and Closes a Buzzer Circuit in This Code Teacher.

can easily make this apparatus which will send code both slow and fast as the speed can be varied nicely.

The dimensions are immaterial and may be made to suit the experimenter. The woodwork of this apparatus is very simple to make. The four small legs are mortised into the base so as to give greater strength. The brass parts are made as shown in the sketch. The paper tape is made by taking a strip of heavy paper (photograph or other binder rolls, cut into ½" strips); the dots and dash perforations are punched in with a regular ticket punch, care being taken to keep the spaces even between the characters and also the spaces between the dots and dash perforations. The accompanying hook-up is a good one, as it also gives the experimenter a chance to become accustomed to the loose coupler.

Contributed by HENRY J. LEISNER.

REPAIRING STORAGE BATTERY TANKS.

A successful method of repairing cracks in the hard rubber tanks used as containers for the electrolyte and plates of storage cells is as follows: Remove the plates and electrolyte, thoroly dry the rubber wall, and when dry widen the cracks by using an old hacksaw blade. This done, insert into the now widened crack an ordinary rubber band of sufficient size to fill the aperture fairly well. Sprinkle over the band a little sulfur, and apply a hot soldering iron, thus subjecting the broken surface to a vulcanizing process. Tank is ready for immediate use, and will be found as tight as when new.

Formulas for Flux and Solder:—The following fluxes will be found desirable to use for soldering and welding various metals:

For steel and iron use salammoniac or

FIRST PRIZE, $3.00

A 4,000 METER "VEST-POCKET" RADIO SET.

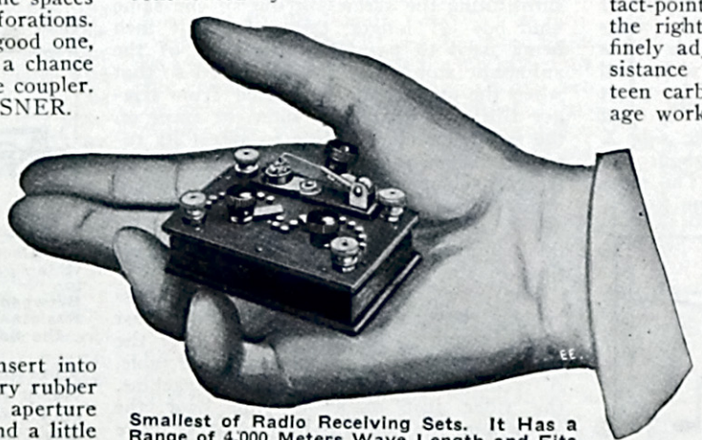
The accompanying photograph shows a hand-made "vest-pocket" wireless receiving set which will tune up to 4,000 meters. The case is made of ⅛ inch cigar box wood, and measures 3 inches long, 1½ inches wide and ⅞ inch high. The binding posts were taken from old dry cells the contacts made from filister-head screws with the heads filed down and the switch arms cut from sheet bronze. The knobs are E. I. Co., standard ones; the knob at the left controlling eleven points on the primary, while the one at the right controls the same number on the secondary winding. The transformer is wound with No. 36 double silk-covered copper wire, multi-wound and staggered.

The ⅛" square brass detector arm, sold ered in a steel ball, gives every movement required for crystal adjustment. The cup is also sliding and fitted with a set-screw for clamping crystals, while a tiny condenser is included and shunted across the 'phone posts. All metal parts are nickeled.

With a piece of galena, this set has successfully rec ded Arlington at night and tests have been made in the office of J. H. Bunnell & Company, New York City, where it was found possible to copy "Wanamaker's" at Philadelphia, Fire Island, Sea Gate, Brooklyn Navy Yard, and a score of others, ranging from 200 meters wave length to 4,000, which is the total capacity of the set.

It is actually *Arlington in your hand*, and it does some work that ordinarily would be expected from a standard receiving set, as the signals come in *clear and loud*. 3,200 ohms receivers are used with it.

Contributed by HERBERT E. HAYDEN.



Smallest of Radio Receiving Sets. It Has a Range of 4,000 Meters Wave Length and Fits the Vest Pocket.

borax; for zinc use chlorid of zinc; for lead use tallow or resin, and for brass use salammoniac or sulfuric acid.

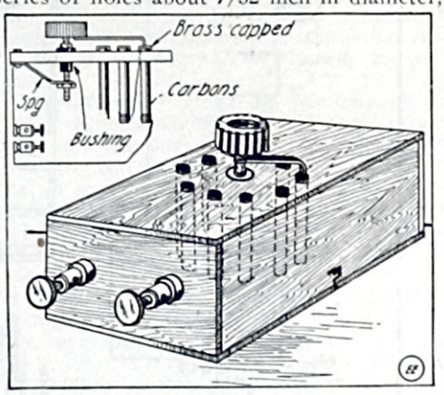
The best solders for different metals are as follows:

For lead use two parts tin and three parts lead; for tin use one part tin and two parts

THIRD PRIZE, $1.00

RHEOSTAT MADE FROM FLASH-LIGHT BATTERY CARBONS.

To make this unique and efficient rheostat procure a cigar-box about 2½ inches in depth, and in the back panel drill a series of holes about 7/32 inch in diameter,



Efficient Rheostat for Experimental Work, Constructed from Flash-Light Battery Carbons Having Brass Caps.

arranged in a semi-circle as for any "tap" switch. Then obtain some old flashlight batteries and remove the brass-tipt carbon rods. Force these rods thru the holes in the cigar-box, leaving the brass tips only projecting on the outside. Mount an ordinary rotary switch on the panel with the lever touching the brass caps as it is rotated.

The carbons should be connected in series, with leads brought out from the switch blade and from the first carbon in the series. Two binding-posts may be mounted on the end of the cigar-box, with the two leads connecting to the binding-posts. The brass caps make excellent contact-points and the carbons have just about the right resistance to make the rheostat finely adjustable, by adding very little resistance at a time. About twelve to fifteen carbon rods should be used for average work.

Contributed by
JOHN S. WILLIAMS.

lead; for aluminum-bronze use four parts copper, four parts zinc, and three parts borax; for aluminum-brass use seventy parts copper, thirty parts zinc and five parts aluminum. A mixture of tin and bismuth in the proportion of 86 to 14 per cent is also good. For bronzing use half copper and half zinc.

Contributed by W. E. Rhodes.

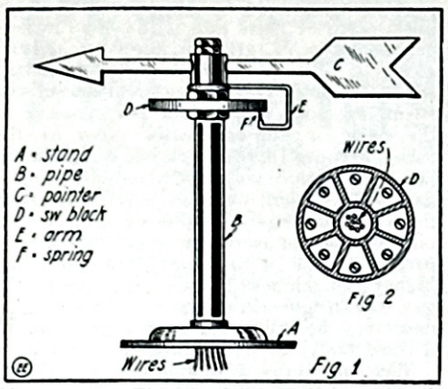
SIMPLE BATTERY INSULATOR.

Sometimes the porcelain insulator, which separates the zinc from the carbon in a carbon cylinder battery, becomes lost or broken. A substitute can be immediately supplied by breaking the neck from a bottle and inserting this in the battery in place of the porcelain.

Contributed by K. M. COGGESHALL.

AN ELECTRIC WIND DIRECTION INDICATOR.

In Fig. 1, A is the stand; B the pipe standard; C the pointer; D switch block; E the switch arm and F the spring contact. The switch block D is fastened securely



Home-made Electric Wind Direction Indicator, which Enables You to Know How the Wind Is Blowing by Means of an Annunciator.

to the pipe B, while the vane, pointer and arm revolve with the wind. Fig. 2 is a view of the switch block and the wires in the pipe which are connected to the various metal segments, each one corresponding to a different point of the compass, as N.—N.E.—E., etc.

The wires are connected to an eight-magnet annunciator or flash lamp board, properly labeled.

The arm E makes contact with a particular metal plate when the pointer is in a certain position, as becomes apparent.

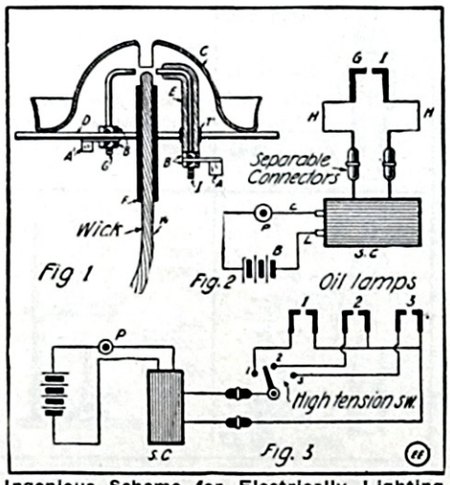
Contributed by

H. CARLETON WHITE.

LIGHTING OIL LAMPS BY ELECTRICITY.

The accompanying diagram shows an arrangement I use to eliminate the disadvantages of oil lamps. Fig. 1 is a cross-section of an ordinary oil lamp burner, in which C is the slotted cap; D, the perforated base; F, the oblong tube which holds the wick W. G, is the grounded terminal and consists of a piece of rod or wire, about 1/16 of an inch in diameter, bent, and threaded on one end as shown. It is held in place by the two nuts, B.

The insulated terminal is seen at I and it is also made of 1/16 inch rod, but it is run thru the glass tube, E, which is bent in an



Ingenious Scheme for Electrically Lighting Oil Lamps, Utilizing the Jump Spark Coil. One Spark Coil May Be Used to Light Several Lamps when So Desired.

alcohol or gas flame, to conform to the rod I. I is first cut to the proper length and inserted in the tube E, then they are bent as shown. I is held in place by the two rings of asbestos cement, T, T¹ (one on either side of the base, D). A and A¹ are the terminals to which the high tension cables are attached.

Fig. 2 is the wiring diagram in which B is the battery; L, L, are the primary wires; P is the push button; SC is the spark coil (about 3/16 to ¼ inch spark rating is sufficient); HH are the high tension wires; I is the insulated terminal and G is the grounded terminal. To use it it is merely necessary to turn the wick up so that the spark between I and G will pass thru its upper end. To facilitate refilling the lamps the leads HH should be provided with separable connectors, one in each high tension lead. One spark coil will light a number of lamps, a high tension distributor switch being used to switch the spark from lamp to lamp, Fig. 3.

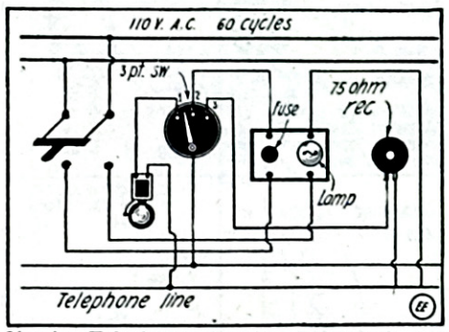
Contributed by PARK GOODE.

A 110 VT. A.C. TELEPHONE.

I was considerably in need of a telephone, and not desiring to buy one, I made my own plans as described herein, which produced very satisfactory results. It works on 110 volt current, using No. 14 iron wire with 500 feet between stations.

To ring second party, place switch lever on point 2 and close D.P.S.T. switch. This will then ring the party.

To talk put switch lever on point 3 when both parties can converse; that is, you talk and listen over receiver. Leave switch lever on point 1, when other party can ring you. A battery may be connected in series



Simple Telephone Circuit Employing 110 Volt A.C. Thru Lamp to Ring Bell. Receiver Is Used for Talking and Listening.

with the 75 ohm receiver to improve the talking quality. Use a 16 C.P. lamp in one socket and a 2 ampere fuse plug in remaining fuse receptacle.

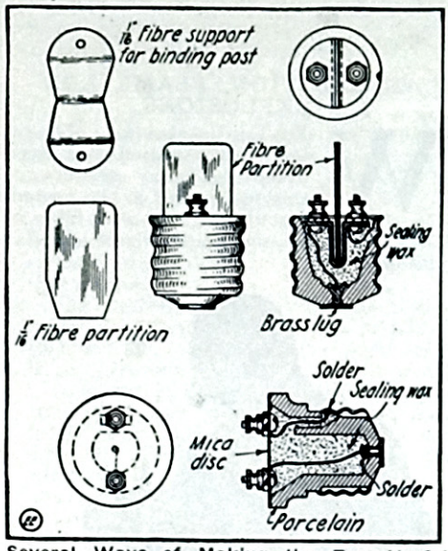
Contributed by RALPH AGNEW.

HOW TO MAKE CHEAP ATTACHMENT PLUGS.

An extension plug, which is very convenient for experimental purposes, may be made from the base of a broken lamp or from a blown plug fuse.

If the lamp base is used, the glass should be entirely removed, taking care not to break off the two wires, the ends of which should be scraped bright. Cut out two pieces of sheet fibre or heavy cardboard, soaked in melted paraffin, having the shape indicated in diagram. Then two holes should be cut to admit the screw of two small binding posts, and the piece should then be bent on the lines shown to form a "T." Fasten the wires to the under side of the binding posts and see that the piece fits into the lamp base just about flush with the top, or a little lower, with the partition piece in place. Warm the parts slightly, then nearly fill the base with melted sealing wax and quickly press the two pieces into place. The partition separates the contacts and serves as a handle to screw the plug into place.

When the blown plug fuse is used, after the metal cap is removed, it will be necessary to solder wires to both center contact and the outside threaded shell, where the fuse wire was connected. Two holes punched in the mica disc will hold the binding posts, and the cavity should be filled



Several Ways of Making the Ever-Useful Attachment Plug from a Discarded Fuse Plug or Lamp Base Are Shown Above. The Extra Parts Required Are Mostly Scrap.

with sealing wax as in the case of the lamp base.

While these plugs can not be used for permanent hook-ups, they are very handy for experimental or emergency work, and can be made very easily from material readily available at any work bench.

Contributed by M. T. McGEE.

STOCK DRAWERS FOR THE WORKSHOP.

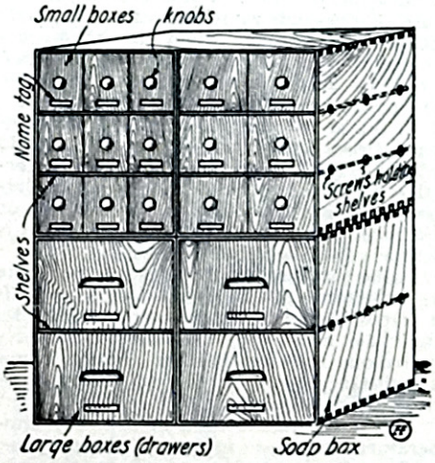
How many amateur workshops can boast of a place to keep stock in a businesslike manner?

Not many! Still it's a simple thing to do.

Obtain several wood boxes, the same size, such as used for soap, etc., and build these up to form shelves. Make smaller boxes to fit in these shelves, say two to six in a large box and put a handle or knob on the front of each to form drawers. A neat and serviceable arrangement is the result.

This is especially handy for the amateur mechanic who is inclined to be too noisy in "flats" and who frequently changes his address. Simply nail a board to keep the drawers from falling out and you are "packed!"

Suitable knobs for use on the small



Why Spend Half an Hour Looking for a Certain Kind of Screw or Drill, when with a Few Small Boxes One Can Construct a Business-like Stock Cabinet.

drawers can be purchased at any hardware store; they are sold for use in repairing tea-pot covers and the like.

Contributed by LEWIS SCRIVEN.

Experimental Chemistry

By ALBERT W. WILSDON

Eleventh Lesson

COMBUSTION, FLAME AND EXPLOSIONS.

WHAT is Combustion? Doubtless this question has been asked by many readers of this series, and in the present installment we will take up the subjects of Combustion, Flame and Explosions.

Fig. 61. How the Blow-pipe Is Used In Chemical Work. A Bunsen Burner Supplies the Flame, a Part of Which Is Blown out Sidewise by the Blow-pipe.

Combustion is a term usually applied to the process of burning, which usually consists in the oxygen of the air uniting with the constituents of the combustible substance. From this we gather that there are certain conditions which must be present in combustion; 1. Something to unite, or, in other words, a combustible substance. 2. Something for this to unite with, or a supporter of combustion. The temperature must also be sufficiently high for this union to take place. It is therefore necessary that none of these conditions are lacking, in order that combustion shall occur. If any of these conditions be wanting, no combustion can take place.

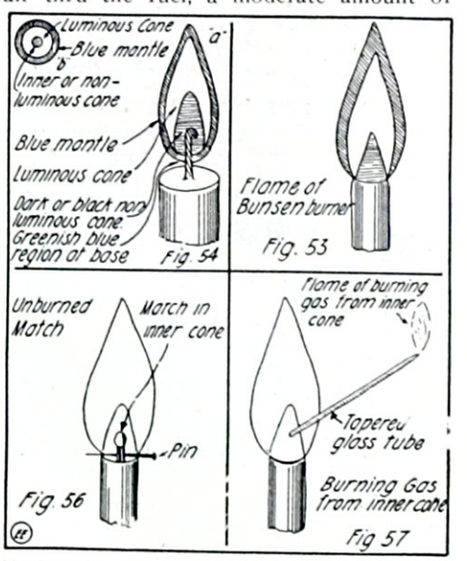
Thus, the combustion of coal is due to the oxygen of the air passing into a state of chemical union with the gaseous hydrocarbons of the coal, forming carbonic acid and water—vapor. Such chemical combinations are always accompanied by the production of more or less heat, as in the case of decaying wood and other vegetable matter. It is only when the action becomes so rapid as to cause the evolution of heat, accompanied by light, that the process is called burning or combustion.

In the above illustration, while the gaseous oxygen of the air has as much to do with the process as the more solid material [coal, wood, paper, cloth, etc.], the latter is alone termed the *Combustible* or *Burning Substance*, while the oxygen is termed the *Supporter of Combustion*.

From the foregoing we can now frame a definition as follows:—Combustion is a rapid chemical union accompanied by light and heat. Fire is a term nearly synonymous with combustion. Flame is not a substance, only a phenomenon accompanying such union.

A few substances burn at ordinary temperature, as for instance, phosphorous, which glows when exposed to the air. Generally substances such as paper, wood, coal, etc., require to be raised in temperature, or be set afire before they possess the power of uniting with the oxygen of the air. [The *Kindling Temperature*, which is taken up later.]

While the absolute amount of heat evolved during the combustion of any burning body is the same, yet the sensible heat may vary according to the rapidity of the process. For example, when phosphorous is exposed to the air at ordinary temperature, it combines very slowly with the oxygen, and gives out but little heat at any one moment, but is diffused over a great length of time. If the phosphorous is set on fire in the air, it burns vividly, and gives out much heat and light for a short time. Again, if the burning phosphorous is placed in pure oxygen, it enters into most vivid combustion, and evolves intense heat and a brilliant light for a still shorter period of time. In the latter instance the heat evolved at any one moment is greater, because it is more rapid, than that given off at the same time during the slower process of combustion. When permitted to proceed to a termination, there is as much heat produced during the whole time occupied in its development. The same remark applies to the coal placed in a furnace. So long as the door of the furnace is open, and there is little draft of air thru the fuel, a moderate amount of heat is evolved, which may last for several hours. But when the door is shut, and much air is drawn thru the coal, the latter is more quickly burned and more heat is evolved during the shorter period of time than before. In the long run there is the same amount of heat evolved.



Various Interesting Details of the Flame from a Bunsen Burner and a Candle.

FLAME

A Flame is a particular form of combustion or burning. Ordinary combustion consists in the oxygen of the air combining with some combustible substance so rapidly as to give out light and heat. When the combustible is either originally a gas, or becomes so by the heat, the combination takes place in the form of flame. *Flame then, indicates the burning of a gas.* In most cases the gas of a flame is a compound of hydrogen and carbon, with minute particles of solid carbon suspended in it, and is formed from the fuel [coal, tallow, etc.] being decomposed by the heat. The heat and light of a flame vary with the gas; hydrogen produces great heat, but little light. The lighting powers of a gas depends upon the proportion of carbon it contains, the particles of which become glowing hot before being consumed. That carbon exists in a solid state in the white part of a flame is readily shown by holding a piece of glass into it [as done in Experiment No. 37, given in the March, 1917, issue of THE ELECTRICAL EXPERIMENTER] which becomes coated with carbon in the form of soot. No soot is deposited in the dark or non-conbustible area of the flame, because there the carbon is in chemical combination with hydrogen, forming a gas. The carbon becomes solid only when the hydrogen deserts it to unite with oxygen.

Gas or vapor is raised to so high a temperature that it becomes luminous; the higher the temperature and the denser the gas, the brighter the flame. This brightness may be increased by the presence of a third body, as when using a limelight.

We can form a definition as follows: Flame indicates the combustion of a gas.

Crabb [in Eng. Synon] determinates between flame, blaze, flash, flare and glare as follows:

"Flame signifies the luminous exhalation emitted from fire. Blaze signifies a flame blown up, that is an extended flame. Flash and flare, which are but variations of flame, denote different species of flame; the former a sudden flame, the second a dazzling, unsteady flame. Glare, which is a variation of glow, denotes a glowing, that is, a strong flame, that emits a strong light; a candle burns only by flame, paper commonly by a blaze, gunpowder by a flash, a torch by a flare, and a conflagration by a glare."

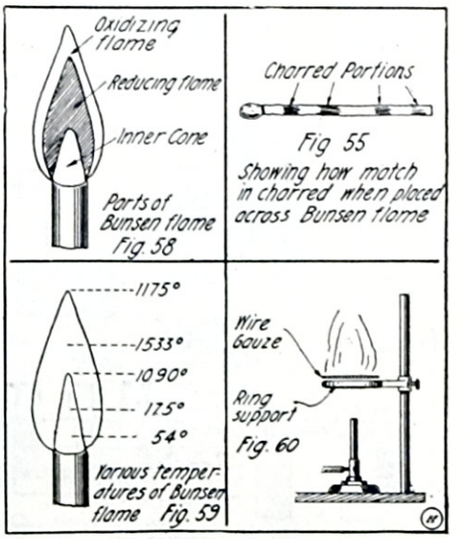
EXPERIMENT NO. 43

Examine the structure of a Bunsen burner flame, one in which the outlines of the inner parts can be clearly seen. Hold it in front of a dark object to bring out the parts more clearly. Also place it in sunlight, if possible, and let its shadow fall on a white paper. Take the lamp in the hand, and, looking straight down into the tube, note the outlines of the flame.

It will be noticed that there appear to be only two parts to the flame of the Bunsen burner (Fig. 53), the lower cone and the surrounding conical cap above.

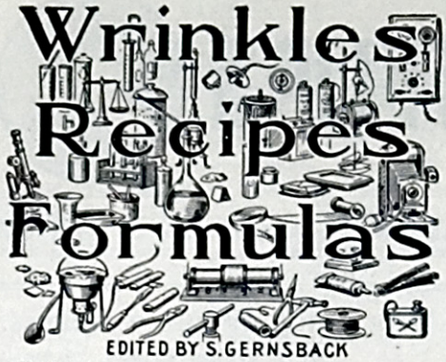
EXPERIMENT NO. 44

Examine the structure of the flame of a candle in the same manner as in the preceding experiment.



Experiments with a Match and Bunsen Flame, Showing in a Practical Way how the Temperature Varies in Different Parts of the Flame.

(Continued on page 933)



Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

INTERESTING CHEMICAL EXPERIMENTS.

The Fiery Fountain: If twenty grains of phosphorous, cut very small, and mixed with forty grains of powder of zinc, be put into four drachms of water, and two drachms of concentrated sulfuric acid be added thereto, bubbles of inflamed phosphorated hydrogen gas will quickly cover the whole surface of the fluid in succession, forming a real *fountain of fire.*

Ghastly Pleasure Party: Dissolve common salt in an infusion of saffron and spirits of wine. Dip some tow in this solution and set fire to it, after extinguishing all other lights in the room. The ghastly effect produced on the faces of all present is very startling.

Tree of Crystals: Put a small quantity of bruised gum benzoin on a piece of thin metal or a saucer; invert over it a tumbler glass, in which place a sprig of wood, or any small-leaved plant, and apply the flame of a candle underneath, so as to melt the gum; dense fumes will soon begin to arise, and deposit themselves in most beautiful crystals of silky texture, on the sprig of wood, in delicate soft flakes, resembling foliage.

Contributed by H. FRANK.

SILVER PLATE.

Dissolve in silver nitrate ($AgNO_3$) enough ammonium chlorid (NH_4Cl) to bring about percipitation; cream to a light paste by adding cream of tartar ($HKC_4H_4O_6$). A little of this paste rubbed briskly on clean metal with a soft cloth will give the desired effect.

Contributed by A. H. DREESNER.

CHEMICAL LANDSCAPES.

These are drawn partly in India ink and partly in sympathetic inks, which are only visible when gently heated. The picture represents ordinarily a winter scene, but when heated the sky becomes blue, the leaves green and flowers and fruit are seen. The materials are as follows: Green, chlorid of nickel; blue, pure chlorid or acetate of cobalt; brown, bromid of copper. If the picture is too highly heated it will not again fade.

Contributed by H. FRANK.

HOW TO COUNT PAPER SHEETS RAPIDLY.

I give below a formula for the rapid counting of paper sheets. I have used this method and find it to be very accurate:

First, the thickness of one sheet of paper is measured in thousandths of an inch with a micrometer, then measure the total thickness of the sheets of paper to be counted. The total thickness is divided by the thickness of one sheet.

Contributed by HOBSON ARNOLD.

HANDY PRINTING AND DARK ROOM LIGHT.

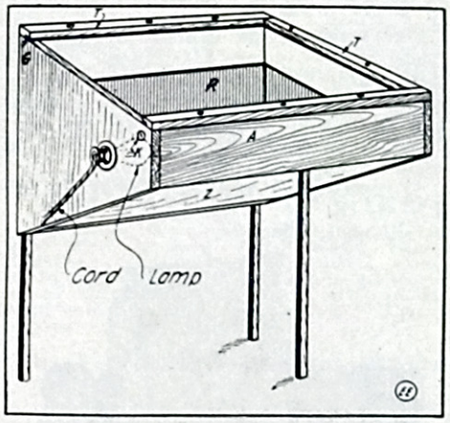
The ordinary light used in a photographic dark room has several disadvantages, namely: it does not allow one to print by the same light and when used as a dark room lamp does not throw the necessary illumination on the developing trays.

This one, however, has neither of the above objections in the idea outlined here as will be seen from diagram. The top, which works in groove G, has either a wooden frame holding a piece of red glass or red celluloid. A handle may be fastened to the red glass by a compound such as given in the February issue of THE ELECTRICAL EXPERIMENTER. The front piece A is pivoted on screws K, at end of the frame. By pulling out the lower edge, the sheet of ground glass R, between the printing frame and lamp may then be inserted after the bulb has been screwed into socket.

When printing, the slide of red glass on top is closed and the printing frame placed on top with light turned on; the negative or paper can be seen by placing them so that the light will shine thru them.

All corners and edges of the case should be made light-tight. Z is a sheet of red glass thru which the developing light falls. The glass may be either held in small grooves rabbeted in or by small grooved moldings.

Contributed by WARD H. INGERSOLL.



Home-made Electric Printing and Dark Room Lamp Combined, Which Will Prove Extremely Useful to the Amateur Photographer.

TO MAKE SOLIDS FROM LIQUIDS.

The spectacle of changing liquids into solids is at once both beautiful and mystifying.

Pour a concentrated solution of water glass (sodium silicate) into a glass and add enough hydrochloric acid to make the solution acid. The solution will turn into a solid resembling an opal and if the dish is inverted, will not fall out.

Dissolve a lump of alum in water and add enough ammonia water so that the solution smells strongly of it. Shake the mixture and it will turn into a thick transparent jelly.

Contributed by NATHAN N. WOLPERT.

FORMULA FOR GUM THAT U.S. USES.

Dissolve 2 ounces of dextrin in 5 ounces of water and 1 ounce of acetic acid and 1 ounce of Spirit of Wine.

To Protect Polished Steel or Iron from Rust: Go over the surface with paraffin, or steep the iron for a few moments in a solution of soda acidulated with muriatic acid. The result is a blue-black coating, not affected by air or water.

ANENT THE MAKING OF STORAGE BATTERY PLATES.

I have just finished reading in the February issue an article by Mr. B. Francis Dashiell, entitled, "Construction of a 6-Volt, 25 A.H. Storage Battery."

Surely, Mr. Dashiell, has not been forming storage battery plates with a paste made of dilute sulfuric acid and lead oxid, either red or yellow, or he would not be advancing that formula. I agree with you that this is not the first time that this method has frequently appeared in print, but it is practically impossible to build a storage battery that is highly efficient in this manner.

The following, tho considered a trade secret, is a method used by all battery repairmen, and I will guarantee good results if the directions are properly followed:

Take red lead 90%, sulfate of ammonia 10%, by weight; mix well, breaking up all lumps or crystals. Make into a thick paste with 26° ammonia. Make no more than what can be applied in two or three minutes. Apply with a wooden paddle to the *positive* plates. Place the pasted plates between sheets of blotting paper, and weigh heavily for twenty minutes in order to remove all surplus moisture. When removing the blotting paper, be careful that the paste is not removed also. Now place the plates in the sunlight, and allow to dry for twenty-four hours.

The same procedure should be followed with the *negative* plates, but using yellow lead oxid 94%, and ammonium sulfate 6%, by weight, and making a paste with 26° ammonia, 85%, and glycerine 15%, by weight.

After drying in the sun, and removing all surplus paste, the *positive* plates are ready for sulfating. This is accomplished by making a solution of sulfuric acid 14%, and water 86%. The positive plates are dipt into this solution, one at a time, withdrawn, and after three or four seconds, again dipt. This is repeated three or four times, and the plates finally left in the solution for eighteen to twenty hours; no more. The plates are then washed in several changes of water for two or three hours. The negative plates do not need sulfating, as they are hard enough without it.

The plates are now placed in the battery box before the electrolyte is added, and connected to the charging source. Electrolyte is added and the battery charged slowly. If the battery is charged and discharged slowly several times, plates removed and washed, and new electrolyte used, the life of the battery will be greatly lengthened.

Contributed by GEORGE FAY.

(Mr. Fay is correct. A similar formula given by him was used for years by the Editor, while he was engaged in the manufacture of storage batteries. He publisht this formula several years ago in his former magazine, "Modern Electrics" (July, 1909, issue).

Mr. Dashiell's formula is a very old one and good results can be had if one is careful and experienced. Mr. Fay's formula, however, is the better.—Editor.)

"CONDENSED MILK" AS A CEMENT.

Condensed milk applied to the edges of the pieces of a broken piece of china will keep the article as intact as the majority of *Cements* on the market to-day.

The writer has mended saucers that have withstood washings in hot water. He has also mended a cracked telescope lens of fairly large size with this unique cement.

Contributed by EDWIN W. ELY.

WITH THE AMATEURS

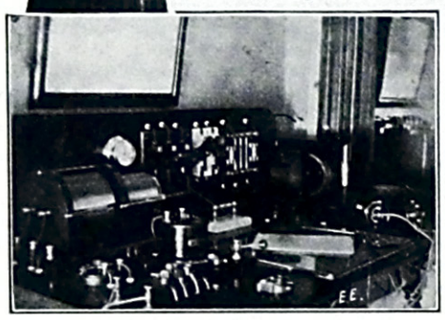
Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month **$3.00** prize for the best photo. Make your description brief and use only one side of the sheet. Address the Editor, "With the Amateurs" Dept.

AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.
This month's prize-winner.

HUGH RENZO'S RADIO STATION.

I present herewith photo of my wireless station and of myself. My radio set consists of the following instruments, which are all clearly shown in the photo:



The Particularly Well Arranged Radio Amateur Station Owned and Operated by Mr. Hugh Renzo, of Paterson, N.J. A Typical High Class Amateur Lay-out.

Receiving:—"Electro" "Professional" loose coupler, one pair of "Electro" 3,000 ohm "Government" phones, "Electro" loading coil, one Murdock variable condenser, an "Electro" Junior fixt condenser for 'phones, and an ordinary mineral detector in which I use galena. With these instruments, in connection with my aerial which I describe below, it is possible for me to receive messages very clearly from the Arlington radio station and other government stations. In favorable weather I often receive messages without lifting the phones from the table.

Transmitting:—The transmitting instruments consist of a ½ k.w. Packard closed core transformer, line protector and kick-back preventer, 4-point switch for supplying current to connections on transformer, oscillation transformer, open spark gap and extra heavy key, all of which are connected to an "Electro" antenna switch.

Aerial:—The aerial used with the above instruments is made up of five strands No. 14 copper wire, spaced two feet apart with Electrose ball insulators at both ends. Total length of aerial is 63 feet, 25 feet high at one end and 52 feet at the other. The lead-in is connected inverted "L" style to a 100 ampere S.P.D.T. switch, which enables me to ground the aerial when not in use.

All instruments, both receiving and sending, are arranged on a table about 30"x50" in such a manner as to allow a space in the center for a piece of plate glass on which to transcribe messages.

Altho I have not interested myself sufficiently to apply for a license, I have adopted the call "OV" and will be very glad to converse with all nearby amateurs.

HUGH RENZO.

Paterson, N.J.

RENSSELAER POLY INSTITUTE WINS RADIO PLANT.

It has been announced by President Palmer Cricketts that $11,000 had been donated to the Rensselaer Polytechnic Institute by Washington A. Roebling, '57; Charles G. Roebling, '71, and John A. Roebling, '88, for the construction of a wireless station to be used in undergraduate and graduate courses and for purposes of research.

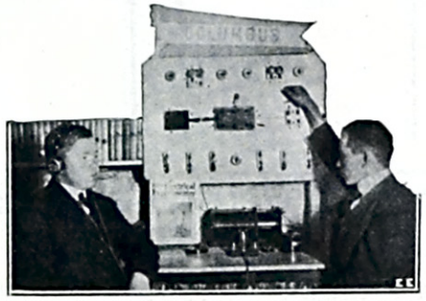
Washington Roebling is the builder of the famous Brooklyn Bridge and Charles Roebling is the president of the John A. Roebling's Sons Company of Trenton, N.J., manufacturers of wire rope. The erection of a station with which it is expected that communication may be had with any wireless station on this continent will start immediately.

A WIRELESS ECHO FROM COLUMBUS, OHIO.

Our receiving set consists of a home-made loose coupler, 5,000 meter loading coil, Murdock 43 plate variable condenser, tubular fixt condenser, Crystaloi detector and 2,000 ohm receivers. We can hear NAA, very plainly at noon and 8:55 at night; also, many other stations.

HENRY AND ANDREW KALPPNER, JR.

Columbus, Ohio.



Experimental Radio Station Operated Jointly by Henry and Andrew Kalppner, Jr., of Columbus, Ohio.

Gongs will not awaken deaf mutes in case of fire, so one institution has installed a fire alarm system for flashing electric lights in the sleeping rooms at night.

A CALIFORNIA AMATEUR.

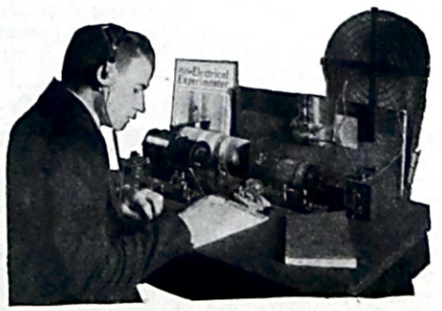
The accompanying photograph shows my station, 6QL. I use a ½-inch spark coil with a Blitzen electrolytic interrupter, Leyden jar and helix for the sending set.

For receiving purposes I use a large capacity loading coil, loose-coupler, variable condenser, galena detector and 3,000 ohm 'phones.

I have obtained splendid results with this set, having received VAE, a commercial station in Canada.

NORMAN RICHARDS.

San Jose, California.



Norman Richards of San Jose, Calif., and His Neat Radio Transmitting and Receiving Apparatus.

Has your station photo appeared in "The Electrical Experimenter"? Why not purchase the electrotype and have some "real" stationery printed with your station picture on it? All of the "regular radio-bugs" are doing it.

THE VOICE OF THE WIRELESS.

By J. Walter Briggs.

The wild wind sings, my aerial rings,
The storm clouds rush and roll,
The stars have gone and the moon ere long
Will be hid—hear the bell-buoy toll;
No fear of the blast as it rushes past
Fills my heart, for 'tis strong and brave,
And I'll do my work and never shirk
As long as there's men to save.

Oh, the steady whirr and the giant purr
Of the dynamo sends the fire,
A rushing test as the key is prest,
Thru my nerves of trembling wire;
With a crackling snap the great spark-gap
Springs to life in a burst of flame,
And I'll do my best if an S.O.S.
Comes staggering in thru the rain.

But when sun is bright and the breezes light,
Thru the pleasant summer days,
My hours are filled with a happier thrill,
And no thots of a watery grave;
I say good-bye to ships that lie
Far out in the ocean's foam,
Just a last farewell, like a broken spell,
From the folks you left at home.

But what of the man who can understand
And master my mighty power?
Give him the praise that's due the brave,
Sing it every day and hour;
Without his plans to guide my hand
I would lie in a useless heap,
My electric flood, like sluggish blood,
Would clot, and I'd fall asleep.

But I quickly wake and like a snake
My zig-zag sparks fly wide,
I brave the deep and the pathless steep,
When my master's by my side;
I fear no foe, thru the space I go,
At the tempest I loudly laugh,
Man's master mind has conquered time,
With the WIRELESS TELEGRAPH.

HERTZIAN WIRELESS CLUB OF NEW YORK CITY.

Herewith is a photograph of the officers of the Hertzian Wireless Club, which has been in existence for some time. The following members were elected as officers at the last meeting (meetings being held every Saturday evening): Honorary member, Mr. Milton L. Frank; chief operator, Mr. S. Schmeltzer; assistant operator, Mr. J. Grossman; secretary, Mr. L. Wallerstein; treasurer, Mr. M. Mogy; editor, Mr. I. Sternberg; chairman of experiments, Mr. J. Hoffman; assistant chairman of experiments, Mr. B. Katzman; stationary inspector, Mr. L. Goldberg; chemical expert, Mr. A. Kamhi; sergeant at arms, Mr. I. Campus.

This club has won second prize in the "Round Up" popularity contest. The members are now building instruments at the club's central station, many of whom are members of the "Radio League of America."

Members of the "Hertzian Wireless Club" of New York City, which Won the Second Prize in the "Round-Up" Popularity Contest.

RADIO OPERATORS—ATTENTION!

The examination of applicants for radio operators' licenses will be discontinued at the Brooklyn Navy Yard and Fort Wood, Bedloe's Island, until further notice.

After February twelfth all examinations for radio operators will be held in the office of the Chief Radio Inspector, 603 Custom House, New York City, every day at 10:00 a.m. to 2:00 p.m., except Saturdays, Sundays and holidays.

All necessary forms will be furnished and filled out at the time of the examination. The papers will be marked and licenses issued as soon after the examination as possible.

RADIO CARRIES 11,500 MILES.

A wireless telegraph distance record of 11,500 miles was establisht by the steamer *Sonoma*, which pickt up messages from Eilvese, Germany, when two days off Australia, according to Royden Thomberg and Clio Bowers, operators on the *Sonoma*.

Robert W. Ross, Jr., Is a Member of the "Radio League of America" and an Enthusiastic Radio Experimenter Altho Young In Years.

RADIO STATION OF ROBERT W. ROSS, JR.

My wireless station consists of the following: The receiving set, which is on an entirely separate table from my sending outfit, incudes a 1,500 meter loose-coupler a detector of the cat-whisker type, both of which are of my own construction and which may be seen in the photo at the extreme left. My laboratory has telephone equipment also.

I also have a loading inductance, which is connected between the aerial and the balance of the instruments, a regular loading coil (12-inch tuner used as a loading coil). I have a rotary variable condenser, a fixt condenser and a pair of Brandes' 2,000 ohm 'phones.

For sending I have a 1½-inch spark coil, a small copper wire helix and a key with fairly heavy contacts, which is mounted on the table with the receiving set. There is a 40-foot, 5-wire aerial with 1½ feet spacing, elevated 40 feet from the ground.

With this apparatus I have heard a good many commercial stations, and numerous Amateurs, and I can send from 8 to 10 miles. I use the house current, together with a step-down transformer for sending. I am a member of the *Radio League of America*.

ROBERT WILSON ROSS, JR.
Philadelphia, Pa.

Amateur News

The Triangle Experimental and Research Laboratories Sighs Long and Deep.

In the February issue of the "EE" an article in a corner of the "Amateur News" Department called attention to the fact that the hard-working "Radio-bug," J. L. Cermak, E.E., has been guilty of establishing a laboratory for the use of the members of the Yorkville Radio Development Association and for the benefit of all outside radio-bugs who are not fortunate enough to be members. A very small charge is made for the work done for non-members.

Now, since that article was publisht, we have had a solid month of answering queries, designing sets, et cetera and, believe us, it is a wonder that those human encyclopedias—Messrs. H. Gernsback and Associates—are not on the roll of honor of the Asylum for Over-worked Radio Men and Retired Ether-Hounds.

Alas! We have had a taste of what mental damage a frenzied "radio-hound" can do when he runs wild. As soon as that article appeared in old reliable "EE," questions, proposals, etc., came pouring into our letter-box. Well, "EE" (God bless it anyway), is responsible for this. The directors of the laboratory asked Mr. Cermak to become the laboratory head. Mr. Cermak refused, and asked that his assistant, Mr. F. Smith, be appointed in his stead. This was done. Monsieur Cermak is frequently seen in company with a charming blonde, and it is thought that this may have something to do with his refusal to become the laboratory head.

Now, "bugs," if you have a question to ask (not if you have "EE" at hand always) or a "kick" to give, don't be bashful, send it. Come on, "radio hounds," do your worst; we're used to it now. Here is the address of our kennel. Triangle Experimental Laboratories, 73 East End Avenue, New York City.

The Colorado Springs High School Electric-Radio Club.

The wireless enthusiasts of this high school have succeeded in organizing a Radio Club of fifty members. The organization has had its club room and the funds for the buying of instruments contributed by the school board. This organization was formed for the purpose not only of studying wireless telegraphy and telephony, but also of studying high-frequency currents and other interesting electrical subjects. The members are chasing knowledge at a high speed and will have a complete set of high grade instruments to help on their quest very soon.

The officers elected were:—Samuel Garth, President; Paul Mechling, Vice-President; William Greenlee, Secretary-Treasurer; Julius Oberndorfer, Librarian; and C. E. Colburn was elected as an honorary member. For further information write Shadrack Franklin, 1130 N. Cascade Avenue, Colorado Springs, Colo.

Experimental Radio Club of Philadelphia, Pa.

The Experimental Radio Club of Philadelphia, Pa., was successfully organized on January 5, 1917, thru the efforts of Messrs. Crippen and Holloway.

The club includes among its members a number of young colored men interested in wireless, tho it has a membership now of only seven.

A course of instruction in the radio art, sufficiently broad enough to enable the graduate to secure an Amateur First Grade License, will be given by Messrs. Crippen and Holloway. Mr. Crippen, who is the President of the Club, holds an Amateur First Grade License and his call is 3 JI.

Besides Wilbert W. Crippen, President, the club has elected R. Marshall, Secretary and Treasurer. All interested should communicate with Messrs. Crippen and Holloway, 2038 Turner Street, Philadelphia, Pa.

The New Haven Radio Association.

The New Haven Radio Association, at its recent annual election of officers on January second, elected the following members to office:—President, W. F. C. Hertz; Vice-President, R. Merwin; Secretary, R. H. Campbell; Treas., A. P. Seeley.

The club has been meeting every Tuesday evening at the club room in the Y.M.C.A. Building. Since last spring, when the club was started, the membership has increased to twenty-two members. Communication should be addrest to the Secretary, 365 Edgewood Avenue, New Haven, Conn.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur News" Section, The Electrical Experimenter, 233 Fulton St., New York City.

Amateurs of Portland, Ore., Organize Radio Association.

At a meeting held at 325 Morgan Building on December 15, 1916, the Amateurs of Portland organized an Association to be known as the *Northwest Audion Association*. A constitution had been drawn up previously by a Committee and was read and accepted. The purpose of the Association is to advance and develop the art of Radio, and give to those who wish it, a chance to go deeper into the subject. Dues were fixt at $0.25 per month. Any person holding a Government License or who is interested in the art is eligible for membership, not only in Oregon but in the Northwest. Officers were elected for one year. Following is a list of officers for the year 1917:—President, C. L. Austin; 1st Vice-President, E. W. Berk; 2nd Vice-President, J. M. Hurtt; Secretary, P. W. Dann; Treasurer, R. T. Galyean; Sergeant-at-Arms, B. W. Montgomery; Chief Inspector, C. L. Austin.

Any persons or clubs wishing to communicate with the Association may do so thru the Secretary, P. W. Dann, 6315 Sixty-third Ave., S.E., Portland, Ore.

The Lowell Radio Club.

The Lowell Radio Club was organized Saturday, January 6, 1917, at the home of Everett E. Taylor, 156 Winthrop Avenue, Lowell, Mass. The meeting was well attended and the officers elected were:—President, Everett E. Taylor; Vice-President, Wilder A. Fernold; Secretary, William H. Carney; Treasurer, Caleb F. Rogers; Associate Directors, Charles H. McMaster; David H. Hanson; Warren R. Entwistle; Elmer A. Scott; and Franklin S. Coppen.

The club was organized to meet the needs of the rapidly increasing number of amateurs in Lowell, who hitherto have not been represented by an organization and so have not been able to secure the proper recognition.

The progressive plans of the club have aroused an enthusiastic spirit among its members, which argues well for its future success. Correspondence with other clubs is invited and all interested should address the Secretary, Lowell Radio Club, Lowell, Mass.

OFFICIAL LIST LICENSED RADIO AMATEURS NOT TO APPEAR UNTIL NEXT ANNUAL GOVERNMENT CALL BOOK.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of August, 1916. (Continued)

Call Signal	Owner of station	Location of station.	Power kilowatts.
	SIXTH DISTRICT—(Cont'd.)		
6AFD	Manasse, Gerald H.	102 Union St., Napa, Cal.	.5
6MH	Mills, Herbert R.	1721 Brush St., Oakland, Cal.	.5
6SZ	Palmtag, Lloyd A.	316 E. 3d St., Watsonville, Cal.	1
6RY	Ridderhof David.	122 Witmer St., Los Angeles, Cal.	1
6FD	Roebuck, Fred.	601 N. 2d Ave., Phoenix, Ariz.	1
6KR	Roitsch, Geo. A.	950 Olive Ave., Coronado, Cal.	.5
	Sacred Heart College.	San Francisco. *See* Bernard F. McNamee.	
6RS	Seares, Richard.	351 Palmetto Drive, Pasadena, Cal.	.5
6AN	Seeberger, Samuel H.	5990 Canning St., Oakland, Cal.	.5
6QJ	Shannon, Thomas J. P.	1148 5th St., Santa Monica, Cal.	1
6ADC	Shiner, Gerald E.	126 S. Philadelphia St., Anaheim, Cal.	.5
6JB	Tassey, Glenn J.	1080 E. 3d St., Pomona, Cal.	.5
6FT	Terman, Frederick E.	Stanford University, Cal.	.5
6ACE	Trout, Delbert C.	506 Palm Ave., Burbank, Cal.	.5
6KY	Weidner, Arthur C.	3 30th St., San Francisco, Cal.	.5
6ADF	Youngstrom, Chas. H.	Ontario, Cal.	1
	SEVENTH DISTRICT		
7AO	Carpenter, Charles B.	300 Oak St., Pullman, Wash.	.5
7AL	Creeden, James.	Getchell, Wash.	.5
7AN	Hessey, Randolph.	1223 South G St., Tacoma, Wash.	.5
7AW	Kessler, Chas. W.	348 24th Ave., Seattle, Wash.	.5
7AA	Motz, Wm. H.	4608 South J St., Tacoma, Wash.	.5
7AQ	Straney, Orral J.	R. F. D., Albany, Oreg.	1
7AM	Vance, Harold C.	Pullman, Wash.	.5
7AR	Van Inderstine, Furness.	107 E. Washington St., Lewistown, Mont.	.5
	EIGHTH DISTRICT		
8AIK	Addington, Charles A.	22 N. Market Space, Springfield, O.	.5
8SBJ	Barnes, Vernon.	Brecksville, O.	.5
AIX	Bruner, Clyde G.	1050 Grove St., Defiance, O.	.5
8JS	Cunningham, John P.	Bellefonte, Pa.	.5
8AJD	Darr, Clyde E.	125 Leverette St., Detroit, Mich.	.5
8AHI	Duerk, Karl.	1000 Wilhelm St., Defiance, O.	.5
8IE	Finch, William G. H.	434 W. Court St., Cincinnati, O.	1
8AKI	Gravatt, Otis T.	Greenville, Pa.	.5
8AIO	Hildebrank, Almer M.	128 Atwood Ter., Bellevue, O.	1
8AKL	Hopkins, Waid.	3125 Peach St., Erie, Pa.	.5
8AJW	Inskip, Leonard S.	514 Glenwood Ave., Buffalo, N. Y.	.5
8AKM	Miller, Adam R.	17 3d St., Greenville, Pa.	.5
8PS	Peterson, Edwin L.	1406 Arch St., Pittsburgh, Pa.	.5
	EIGHTH DISTRICT—(Cont'd.)		
8AIW	Saunders, W. King.	High School, Charlevoix, Mich.	.5
8AHR	Smart, John T.	233 S. High St., Marion, Ohio.	1
8AJK	Stoeckel, Harold D.	2015 Bailey Ave., Buffalo, N. Y.	.5
8AJE	Taylor, Laurens A.	101 Lyceum St., Geneva, N. Y.	.5
8AHT	Thompson, R. R.	1462 Pennsylvania Ave., Detroit, Mich.	.5
8AIB	Warren, Edwin C.	Capac, Mich.	1
8AHM	Williams, Frank S.	790 Franklin Ave., Columbus, O.	1
	NINTH DISTRICT		
9AGW	Andersen, Arthur C.	3518 22d Ave., S., Minneapolis, Minn.	.5
9SZ	Baker, Lyle D.	Forest City, Ia.	1
9TC	Baldwin, Kenneth D. H.	323 Moss Ave., Peoria, Ill.	.5
9QX	Blessman, Charles W.	1951 N. 27th St., Kansas City, Kan.	1
9HJ	Coleman, Winston.	R. F. D. No. 7, Lexington, Ky.	1
9TI	Eisenhard, Geo. B.	Culver, Ind.	.5
9TZ	Gardner, John A.	Eureka, S. D.	1
9QK	Gjelhaug, John A.	Baudette, Minn.	1
9RN	Gleason, Francis C.	Gilman, Ill.	.5
9BR	Hefferman, Orin.	1017 W. 5th St., Waterloo, Ia.	.5
9AB	Hill, James H.	1822 Darrow Ave., Evanston, Ill.	.5
9SX	Hutchinson, Maxwell W.	Middlebury, Ind.	.5
9TZ	Isaak, Edward R.	Eureka, S. D.	1
9SB	Johnson, Harold N.	311 E. Lincoln Highway, De Kalb, Ill.	.5
9RJ	Kamler, Ben R.	807 S. 18th St., St. Joseph, Mo.	.5
9SZ	Kibbee, George G.	Forest City, Ia. (Partner of Lyle D. Baker).	1
9GX	Kirbach, Carlton W.	2224 Gay St., Fort Wayne, Ind.	1
9RT	Kuzdas, Rudolph J.	1236 Ridgeland Ave., Berwyn, Ill.	.5
9TL	Longbrake, Forest.	8600 Independence Ave., Shefield, Mo.	1
9QJ	Nowak, Ernest I.	2218 Francis St., St. Joseph, Mo.	1
9SC	Rawlings, Charles L.	522 N. West St., Lebanon, Ind.	.5
9QR	Romey, Paul K.	Columbia, Ind.	1
9QL	Shumate, Bayard.	504 S. Lebanon St., Lebanon, Ind.	.5
9QT	Smith, Eddie.	688 S. 39th St., Louisville, Ky.	.5
9TF	Spencer, Herbert H.	2149 Marshall Ave., St. Paul, Minn.	.5
9SY	Swain, Fred W., Jr.	3936 N. 22nd St., Omaha, Neb.	1
9AAS	Zehring, Laurence L.	410 W. Washington St., Bouffton, Ind.	.5

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of September, 1916.

Call signal	Owner of station.	Location of station.	Power kilowatts.
	FIRST DISTRICT		
1NL	Ackerman, Henry J., Jr.	408 Mill St., New Bedford, Mass.	.5
1QV	Atkinson, Earl J.	137 Plunkett St., Pittsfield, Mass.	1
1NP	Barrett, Louis G.	38 Gilsum St., Keene, N. H.	.5
1HT	Bates, Lee A.	8 Moen St., Worcester, Mass.	.5
1CT	Bernstein, Nathan.	74 Kingsdale St., Dorchester, Mass.	.5
1CV	Black, Donald W.	165 Trenton St., Melrose, Mass.	.5
1GJ	Butler, James B.	26 Burlington St., Woburn, Mass.	.5
1VX	Fabbri, Alessandro.	Bar Harbor, Me.	.5
1WL	Gaillardet, Louis A.	248 Washington St., Weymouth, Mass.	.5
1QI	Garfield, Harold E.	129 Liberty Ave., Rockland, Mass.	.5
1QB	Harmon, Nathaniel P.	140 Burgess St., Manchester, N. H.	.5
1BS	Heath, Waldo S.	121 Rowley St., Winstead, Conn.	.5
1PU	Holbrook, Earle G.	13 N. Taunton Ave., Seekonk, Mass	.5
1BO	Johnson, Arthur.	23 Harwood St., Lynn, Mass.	.5
1AK	Johnson, Carl E.	11a Edity Ave., Everett, Mass.	.5
1UG	Kuntz, Albert.	Stamford, Conn.	.5
1QA	LaBree, Harold.	2 Bryant Rd., Dexter, Me.	1
1MM	Leighton, Harold C.	24 Mudge St., Lynn, Mass.	.5
1BW	Lippincott, H. H.	West Chelmsford, Mass.	.5
1OG	McKee, Hugh W.	66 Burlington St., Woburn, Mass.	.5
1CW	McShane, Edward P.	13 Cottage St., Lewiston, Me.	.5
1CE	Marble, Harold E.	609 Pleasant St., Brockton, Mass.	.5
1UA	Merz, Arthur Frederick.	185 Seymour St., Hartford, Conn.	.5
1BR	Parsons, George A.	Gloucester, Mass.	1
1VQ	Peabody, David.	28 Lexington Ave., Greenwich, Conn.	.5
1ME	Priest, Walter F.	5 Oliver St., Everett, Mass.	.5
1PM	Randall, Eugene F.	27 Cotting St., Medford, Mass.	.5
1TM	Roberts, Wilfred V.	320 Point St., Providence, R. I.	.5
1DA	Stevens, Charles R.	133 W. Main St., Marlborough, Mass.	.5
1OE	Tarplin, Emanuel.	325 Boston St., Lynn, Mass.	.5
1MJ	Tarylor, Ralph E.	249 Palmer St., New Bedford, Mass.	.5
1IQ	Twombly, Francis H.	57 Pleasant St., Framingham, Mass.	.5
1QC	Wheeler, James A.	132 Hanover St., Manchester, N.H.	.5
	SECOND DISTRICT		
2ATG	Baier, Elmer G.	444 7th Ave., Brooklyn, N. Y.	.5
2ATW	Carman, Harry H.	217 Bedell St., Freeport, N. Y.	1
2ATQ	Coddington, Wilbur E.	34 Crescent Pl., Middletown, N. Y.	.5
2ER	Daw, Edwin M.	7402 17th Ave., Brooklyn, N. Y.	.5
2FW	Ford, Fullerton.	1202 Cortelyou Rd., Brooklyn, N.Y.	.5
2ATB	Hand, Francis E.	21 S. Kentucky Ave., Atlantic City, N. J.	.5
2ATY	Harring, Louis E.	Little River, N. J.	.5
2ATC	Harrison High School.	Westchester, N. Y.	.5
2ATV	Herrmann, Edwin.	Keansburg, N. J.	.5
2ABU	Hoffman, Karl.	5 Summit Ave., Albany, N. Y.	.5
2ASZ	Howland, George A.	1001 5th Ave., Asbury Park, N. J.	.5
2ATP	Jacobs, Joseph.	65 W. 127th St., New York, N. Y.	.5
2ATR	Klosner, Morris.	2404 Crotona Ave., Bronx, N. Y.	.5
2ATS	Little, Harvey.	1280 Asbury Ave., Asbury Park, N. J.	.5
2LU	Maurer, J. F., Jr.	682 Broadway, West New York, N. J.	.5
2ATN	Mayer, William G.	Long Branch, N. J.	1
2ATE	Mulcahy, William T.	3590 Park Ave., New York, N. Y.	.5
2ATA	Munroe, Kenneth H.	403 East Ave., Perth Amboy, N. J.	.5
2ATF	Penfield, Walker.	Pelham, N. Y.	.5
2ATD	Pierson, Ronald P.	842 Lake St., Newark, N. J.	.5
2EW	Radio Club of Westchester.	2320 Newbold Ave., New York, N. Y.	.5
	SECOND DISTRICT—(Cont'd.)		
2ATZ	Taber, Raymond.	17 N. Hamilton St., Poughkeepsie, N. Y.	.5
2ATO	Tilton, Ellsworth N.	1109 Dorchester Rd., Brooklyn, N. Y.	.5
2EO	Van Wickle, Charles F.	530 W. 174th St., New York, N. Y.	.5
2AUA	Warner, Edward T.	143 5th Ave., Roselle, N. J.	.5
2ATX	Wirth, Augustine.	528 High St., Newark, N. J.	.5
2ATU	Woodruff, Kenneth R.	616 Clifton St., Athenia, N. J.	.5
2QM	Willis, Wm. S.	347 W. 14th St., New York, N. Y.	.5
	THIRD DISTRICT		
3FE	Angell, Otis P.	133 S. 49th St., Philadelphia, Pa.	.5
3FO	Bancroft, Ernest S.	Kennett Square, Pa.	.5
3CV	Burg, Edwin W.	910 10th St., N. E., Washington, D. C.	.5
3ES	Faulconer, Jack.	2022 Columbia Rd., Washington, D. C.	.5
3AGO	Fretz, John C.	368 S. Olden Ave., Trenton, N. J.	.5
3ER	Glocker, Robert L.	4111 Belview Ave., Baltimore, Md.	.5
3DP	Hook, Ernest S.	3731 Reistertown Rd., Baltimore, Md.	.5
3AHW	Knight, Albert S.	520 N. 8th St., Richmond, Va.	.5
3BN	Maris, C. Emlen, Jr.	41 Owen St., Lansdowne, Pa.	.5
3BX	Sanders, William F.	732 Atlantic Ave., Collingswood, N. J.	.5
	FOURTH DISTRICT		
4BR	Boyett, Stephen L.	1047 Green St., West Tampa, Fla.	.5
4AR	Cole, Harry A.	335 Hill St., Atlanta, Ga.	1
4EI	Cooper, John C., Jr.	326 Market St., Jacksonville, Fla.	1
4EK	Geeslin, James W.	290 E. Linden St., Atlanta, Ga.	.5
4EL	Hyers, Thomas C.	805 Azeele St., Tampa, Fla.	.5
4EJ	Pittman, Robert F.	80 Windsor St., Atlanta, Ga.	.5
4EM	Wilkes, John M., Jr.	914 S. Rome St., Tampa, Fla.	.5
4BN	Gore, Calvin.	819 Orange St., Wilmington, N. C.	.5
4EN	Short, Carl D.	122 Cole St., Macon Ga.	.5
4EO	Williamson, Robert E.	Tallulah Lodge, Ga.	.5
	FIFTH DISTRICT		
5BW	Cook, Paul S.	2911 Judson St., Shreveport, La.	.5
5AD	Smith, John D.	1316 Winston St., Shreveport, La.	1
	SIXTH DISTRICT		
6PW	Fisher, Fiacro J.	Coyote, Cal.	.5
6DW	Glesener, Walter W.	128 S. Grand St., Orange, Cal.	.5
6QL	Howard, Oliver M.	1703 White Ave., Fresno, Cal.	.5
6EL	Mundt, Edward L.	Alameda, Cal. (portable station).	.5
6TS	Thompson, Alan K.	1025 W. 72d St., Los Angeles, Cal.	.5
6KT	Vogler, June C.	Santa Clara, Cal.	1
6EV	Wathen, Edgar J.	1422 Wright St., Los Angeles, Cal.	.5
	SEVENTH DISTRICT		
7BB	Clark, Stanley A.	618 W. Pear St., Centralia, Wash.	.5
7AY	Craig, Dolph L.	1216 Court St., Salem, Oreg.	.5
7WD	Duncan, Willard.	3922 Woodlawn Ave., Seattle, Wash	1
7BC	Ingebrigtsen, Lief.	609 W. Market St., Aberdeen, Wash.	.5
7AX	Laughlin, George F.	Fairfax, Wash.	.5
7AZ	Robertson, Charles G.	277 N. Capitol St., Salem, Oreg.	.5
	EIGHTH DISTRICT		
8JC	Badina, Norman P.	170 E. Ferry St., Buffalo, N. Y.	.5
8ACG	Baer, Dana.	833 Quincy Ave., Scranton, Pa.	.5
8RI	Burgie, John E.	Fillmore, N. Y.	.5
8OY	Farnyak, Carlton S.	Mansfield, O.	1

(*To be continued*)

THE "WIRELESS WIZ" AND THE CARD SHARKS.

(*Continued from page 885*)

were crowded, some badly bruised and disheveled, others snarling and glaring. Tables were overturned and broken; it looked as if a cyclone had just past over.

"You are trapt," the Captain's stentorian tones rang out, "make no resistance or it will fare ill with you," and one after the other the prisoners were brought forward, handcuffed and led to the waiting car. And thus ended the careers for a while of certain wise and crooked gamblers.

The "Wiz" hung around to get all the dope on the system they used and was surprised at its simplicity. Each watcher had a key, battery and induction coil. Wires were run down the walls and under the floor, making contact by means of small pins with wires running thru the table legs. Two small pointed contacts were fastened under the side of the table and by merely pressing his knee against these, the shark at the table closed the circuit. Every time the key was pressed he would receive a slight shock. A special system of signals were used to simplify the transmission of the information.

Joe Culver swore off gambling and was one of the main witnesses against the men, the "Wiz" being the other.

What puzzled me was where the "Wiz" had obtained the blowpipe, but it seems it was among the counterfeiters' belongings he had received.

I thot fame would make an egotist out of him, but he still rolls his own, lets his hands get dirty and to the best of my knowledge still wears the same size hat.

It took me a while to understand about the watch business, but it was also simple. The coil of wire around his waist was connected to the contacts on his glove. By holding the false watch so that one contact touched the case and the other the insulated stem, he had a circuit. The signals sent over the wires acted inductively on the coil and the faint buzz was heard when he apparently listened for the tick of the watch

"A telephone receiver is the most sensitive electrical detecting device, but I couldn't hold one to my ear in that room; hence the false watch" he explained, "and, Paul, the only game of chance worth playing is life," he finished with a smile.

THE EARLY DAYS OF RADIO IN AMERICA.

(*Continued from page 893*)

and connected in series with a pair of head 'phones and a potentiometer controlled battery.

During the year 1902, the output of radio literature increased in a very helpful degree. In its February, 1902, issue *McClure's Magazine* published a long article entitled "Marconi's Achievement; Telegraphing Across the Ocean Without Wires."

The Scientific American of February fifteenth, contained an article written by A. F. Collins, entitled "How to Construct An Efficient Wireless Telegraph Apparatus at Small Cost." I think it is safe to say that the appearance of this article did more to introduce the art of *amateur radio* than anything else that had appeared.

On April twelfth, the *Western Electrician,* of Chicago, published a communication from Dr. Lee de Forest with the heading: "An Interesting Sensitive Flame Experiment," which subsequently I could not help believing started the train of thought which culminated in the development of the marvelous AUDION.

The *Electrical World* of April twelfth contained a long communication signed by Wilfrid Blaydes, which shed considerable light upon the Marconi-Slaby controversy which was then raging in Europe.

In 1902, copies of three books on wireless telegraphy reached this country from England; one written by Richard Kerr, one by George de Tunzelman and Sir Oliver Lodge's "Signaling Thru Space Without Wires."

The first United States Government pamphlet on wireless appeared in 1903, entitled "Instructions For the Use of Wireless Telegraph Apparatus" by Lieutenant Hodgins, U.S.N. This booklet described only the Slaby-Arco *coherer* system. In fact none of these works described anything *beyond* the coherer.

Dr. John Stone Stone took out seventy American radio patents between 1901 and 1904, and Harry Shoemaker forty patents between 1901 and 1905.

In the year 1903 the International Wireless Telegraph Company was formed in America to exploit Dolbear's claims and to push litigation first begun in March, 1901, against Marconi. The claims were based on Dolbear's patent of October, 1886.

In October, 1903, stations were established by the U. S. Signal Corps at Nome and St. Michael's, Alaska.

The summer and fall numbers of *Popular Science Monthly* contained a long article by Prof. J. A. Fleming on "Hertzian Wave Telegraphy." This was one of the best authoritative accounts of Marconi's work up to that time.

In 1903, the author wrote the first book length American treatise on the subject of wireless. The matter was published serially in the *Western Electrician,* Chicago.

In 1903, the Marconi Company opened stations at Chicago, and at Milwaukee. The first International Radio Convention was held in Berlin, Germany, during this year. The report of Mr. John I. Waterbury, one of the American delegates to the convention, appeared in the *North American Review* of November, 1903.

These brief memoranda may well be closed with the advent of the year 1904, as during that year Fessenden's electrolytic detector, de Forest's responder, Dunwoody's carborundum detector, and Marconi's magnetic detector, all made their appearances, furnishing the hungry amateur with a plethora of devices to displace the often blest filings coherer.

The year 1904 clearly marks the beginning of RADIO'S climb to the plane of practicability. On February twentieth of that year the Western Union Telegraph Company's tariff periodical, *The Journal of the Telegraph,* for the first time announced the acceptance of messages for ships at sea.

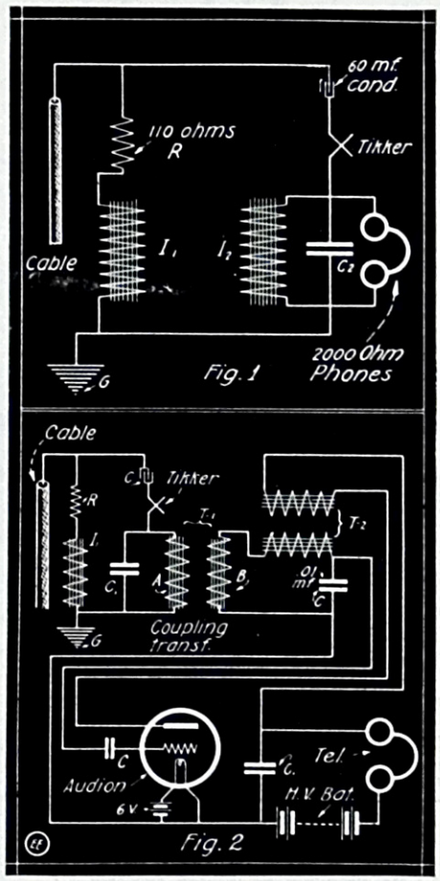
ONE DRY CELL NOW TELEGRAPHS ACROSS OCEAN.

A technical discovery expected to revolutionize ocean cable communication was recently announced by the U.S. War Department and described in a general way in the February issue of THE ELECTRICAL EXPERIMENTER.

The principal drawback to cable communication has been the necessity of employing the visual recorder, requiring the employment of highly trained cable readers. The new invention—the "Audion cable receiver"—is expected to do away with cable readers and bring the operation of ocean cables in line with land line and radio-telegraphy.

The preliminary experiments, which have been in progress for some months, were made at the Government radio laboratories, and the actual tests on an ocean cable have been completed recently. The improvement consists essentially in the adaption of the "tikker" and Audion types of instrument used for receiving the signals in radio-telegraphy which apparatus are connected up in the manner shown in the accompanying diagrams. At Fig. 1 is shown the simplest hook-up for the tikker as given to our readers by Dr. Louis Cohen, who was one of the experts engaged on the problem. He says that the current from a single dry cell (1.5 volts) would be sufficient to give good signals across the Atlantic cable, according to the tests conducted on an actual submarine cable. The incoming battery current (very weak of course) is past thru a resistance R, and inductance I_1, which circuit is shunted by an interrupter or *tikker,* in series with a 60 m.f. condenser and telephone circuit as seen at Fig. 1. The tikker causes the condenser C_2 to charge and discharge at a rapid rate thru the telephones. Thus the signal is made audible.

When necessary for long, high resistance cables, recourse is had to an Audion amplifier, Fig. 2. The tikker breaks up the incoming cable signal and the audio frequency current in circuit "A," is transferred by the iron core coupling transformer T_1,



Methods of Connecting "Tikker" to Submarine Cable, With and Without Amplifier, for Reading Telegraph Code Signals by Sound.

to Audion circuit "B." Transformer T_2 couples the wing of the Audion for tuned signal work.

The tests have been made on the Government Signal Corps cable from Sitka, Alaska, to Seattle, Wash., and the receiving apparatus was installed in the Seattle office. This cable is 1,086 miles in length and has a K.R. approximately equivalent to one of the Atlantic cables.

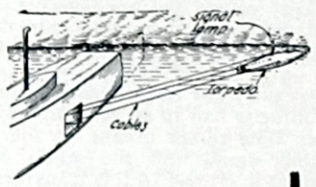
The actual receiver is an ordinary telephone. The feeble current received is normally inaudible in the telephone. It is broken up by means of a slipping contact "tikker" and rendered audible. In order to secure greater sensibility, a tuned Audion amplifier is used in connection with the tikker. The sensitiveness of this apparatus is so great that *less than one-twentieth* of the voltage necessary for operating the "siphon" recorder is sufficient to give good traffic signals.

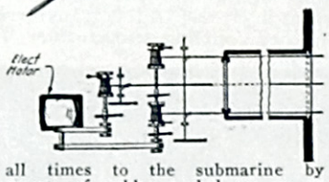
LATEST PATENTS

Positively Controlled Torpedo

(No. 1,212,468; issued to Alfred Extrand.)

A scheme providing for the positive control of a torpedo as seen, the torpedo hull being attached at



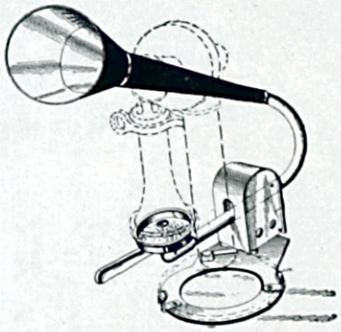


all times to the submarine by means of cables reeled up on or off of motor-driven drums, each drum having a control clutch of its own. Thus the torpedo (of the usual automobile type) can be accurately guided in its course. When the position of the torpedo is desired to be known it is possible to momentarily light an electric signal lamp on the torpedo which can only be seen from astern

Telephone Amplifier

(No. 1,212,785; issued to John L. McMillan.)

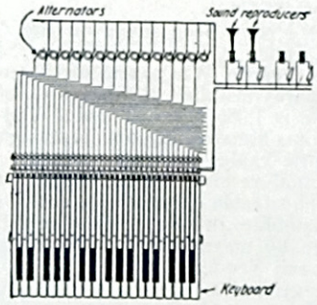
A novel idea in amplifying attachments for use on ordinary telephone, where the amplifier can be



instantly disconnected from the telephone proper and having no rigid connection with it. The invention comprises an amplifying horn so mounted as to be manually movable, first to contact with the ear-piece of the receiver as it hangs on the hook, and then by a continued movement to lift the receiver and permit upward movement of the hook, so that telephone is connected.

Electrical Distribution of Music

(No. 1,213,803; issued to Thaddeus Cahill.)

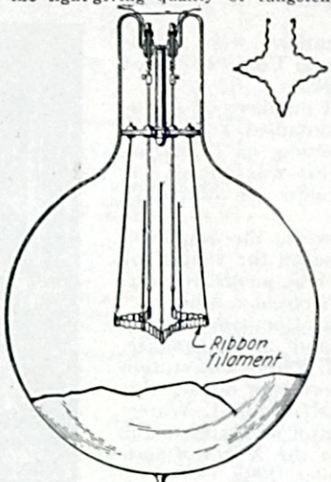


A remarkable exposition of an electrical music distributing scheme whereby a large number of small alternators are positively driven at varying speeds by suitable gearing to motors. The various alternators produce currents having frequencies corresponding to the vibrations of consecutive notes of the chromatic scale. A keyboard similar to that of a pianoforte or organ enables the circuits from one or more alternators to be closed, thus delivering one or more musical note-sounds to the outgoing line (which may be many miles long) and to which sound translating devices, such as telephone receivers with horns, are connected.

Ribbon Filament Lamp

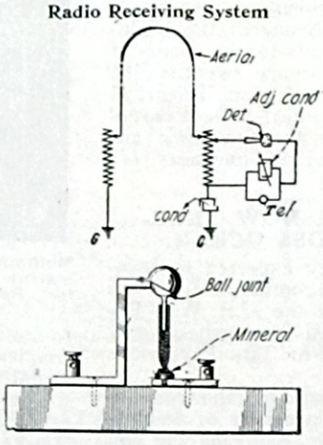
(No. 1,206,333; issued to F. G. Keyes.)

The patentee discloses in this invention a scheme for increasing the light-giving quality of tungsten



filaments in incandescent lamps by forming the filament into crimped ribbons. The ribbons may be mounted in various designs such as in the form of a star, etc. The inventor claims that by such construction he makes possible increased illumination from the filament with the same expenditure of energy as in other lamps.

Radio Receiving System



(No. 1,213,250; issued to G. W. Pickard.)

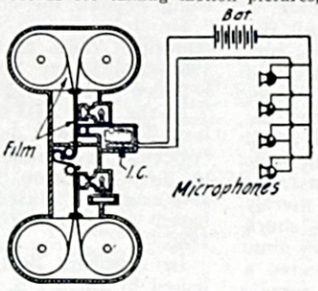
This patent covers the use of the well-known loop form of wave-interceptor, together with suitable tuning inductances and variable condensers as seen. The detector circuit comprises an adjustable condenser, shunted by telephones, with a rectifying mineral detector in series as indicated.

The detector here covered is of simple design, comprising a ball and socket adjustment for the movable contact resting on the mineral (such as silicon), which is held in an alloy fused into a brass cup.

Magnetic Sound Recorder for Talking Movies

(No. 1,213,150; issued to Henry C. Bullis.)

A method of producing sound records for talking motion pictures,

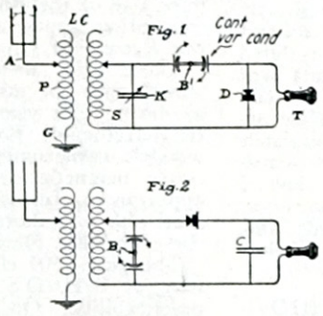


which consists essentially in photographically producing a positive negative master record of sound controlled light flashes. Microphones pick up the sounds and by means of an induction coil IC, the sound controlled currents are caused to influence a source of light acting on a sensitized film. The master negative is printed on a sensitized film containing finely divided metallic material in suspension. Subsequently all of the sensitized coating not hardened by printing the master negative on the sensitized film is removed.

Undamped Wave Receiver

(No. 1,211,963; issued to John A. Proctor.)

An ingenious method of receiving

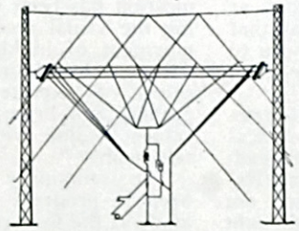


undamped wave radio signals with a simple form of circuit comprising a detector D, telephones T, loose coupler, tuning condenser such as K (Fig. 1), and a continuously variable condenser B^1. The latter has a rotating electrode run at from 200 to 500 times a second, to thus vary the capacity smoothly from zero to maximum, and to produce a corresponding sinusoidal note in the telephones T.

This invention causes the variation of the oscillations of the current delivered to the detector to be smooth and sinusoidal.

Radio Antenna

(No. 1,214,283; issue to Lee de Forest.)

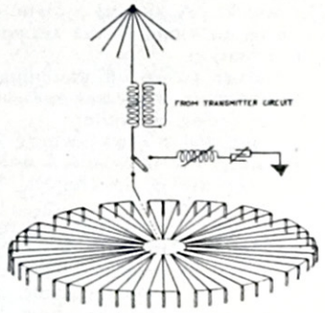


Relates to improved radio antenna design whereby it is possible to increase the capacity of the antenna and simultaneously diminish its radiation resistance, without entailing costly alterations or radical changes in design. This invention provides for an auxiliary earthed-antenna system erected in suitable proximity to and in electrical relation with the main radiating antenna whereby the patentee claims that "a genuine and very marked increase in the energy drawn from the source of supply is obtained and radiated as useful energy."

Antenna for Radiotelegraphy

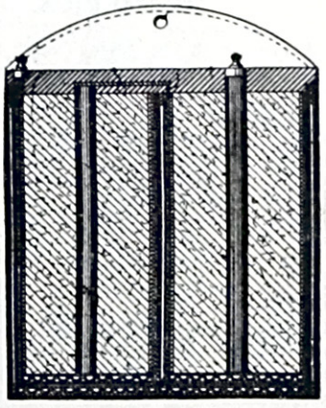
(No. 1,214,591; issued to Gustav Reuthe.)

Unique system for nullifying the effect of atmospheric electricity at high power, long range stations. The high vertical antenna is connected to a portion of the low horizontal antennae as a counterpoise,



while transmitting. When receiving the low horizontal antennae are connected to the receiving instruments, while the high vertical aerial is earthed thru a suitable inductance and capacity so that it can be detuned. By this means the vertical aerial absorbs most of the atmospheric "strays," besides acting as a Faraday cage or "screen" for the low receiving antennae. This arrangement is very desirable as low antennae, owing to their small height and strong damping, are unsuited for radiating energy, while the opposite holds true for high vertical antennae, especially of the umbrella type, in this particular case.

Battery Package



(No. 1,214,836; issued to John Smith.)

This invention relates to a dry cell battery package designed to provide a combined dry cell set and container which shall be both waterproof and heat insulating. Also to provide a battery set and package which may be hung on a nail. The usual zinc bottom is substituted by a waterproof, heat insulating base. The battery may comprise two or more cells, and is sealed at the top by sealing compound.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c EACH

Phoney Patents

Under this heading are publisht electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

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PHONEY PATENT OFFIZZ

No. $\sqrt{\frac{C}{E.R}}$

WILL U. CHEESIT of OBE CITY, U. X.

REDUCING APPARATUS

Spessonification of Patent Fettors **Patent Applicated**

To Whom You All is Concerned:

Be it beknowed to all Bipeds in this country and abroad, and particularly to all fat individuals, fat heads, fat alists, fatlings, as well as fatties that I, Will. U. Cheesit of Obe City, in the county of Fatuity, in the State of Utter Xostion have gradually and painfully invented an apparatus of widespread interest to all Humanity at large.

It is well known to phsychologists and alienists that there is nothing so effective to reduce superflous ombumpoint of stoutish individuals than strenuous exercise, especially marathoning. It is also well known since the earliest days of civilization that fat folks do not like to run far on account of them becoming rapidly heated up while running. The Latin term for this peculiar phenomenon is known to Doctors as *eshofé*, which in our language means *givemairboys*. My stupendous invention overcomes this trouble readily as will be seen. Furthermore while running a fat individual gives up 23,658,979¾ calories of useful heat for every mile covered. This vast amount of energy has gone to seed heretobefore and it is the purpose of my basic discovery to utilize such vast energy for commercial purposes.

Having thus explained the purpose of my invention, I will now describe its most valient as well as vital points.

The victim to be reduced is made to hoof it rapidly on endless rubber belt 3, revolving on its axis supported by bismuth casting 5. On the axis is also mounted a noiseless pewter gear 4 which thru flexible soft rubber transmissions 2, runs the speedometer 7 and cyclometer 1 indicating and recording the speed and distance covered. Attached to the main axle is also a green silk rubberized belt 9 which connects with fan 8 which has two *ice* blades in order to continuously cool the victim. The blades revolve so fast that they have no time to melt.

Hidden from the victim and attached to the main axle is a secret belt 6 made of chameleon skin for purpose of invisibility. This belt runs around the frosted glass pulley 10 which in turn is connected to a hydraulically prest, noiseless cheese pinion 11. The transmission in turn drives the 22 kilowatt purple dynamo 12 which thru the pale yellow switchboard 13, charges the pink storage batteries 14.

Having thus described from now on until all times my far reaching invention:

WHAT I CLAIM IS:

1° A reducing machine which while reducing collects all expended and expanded energy.

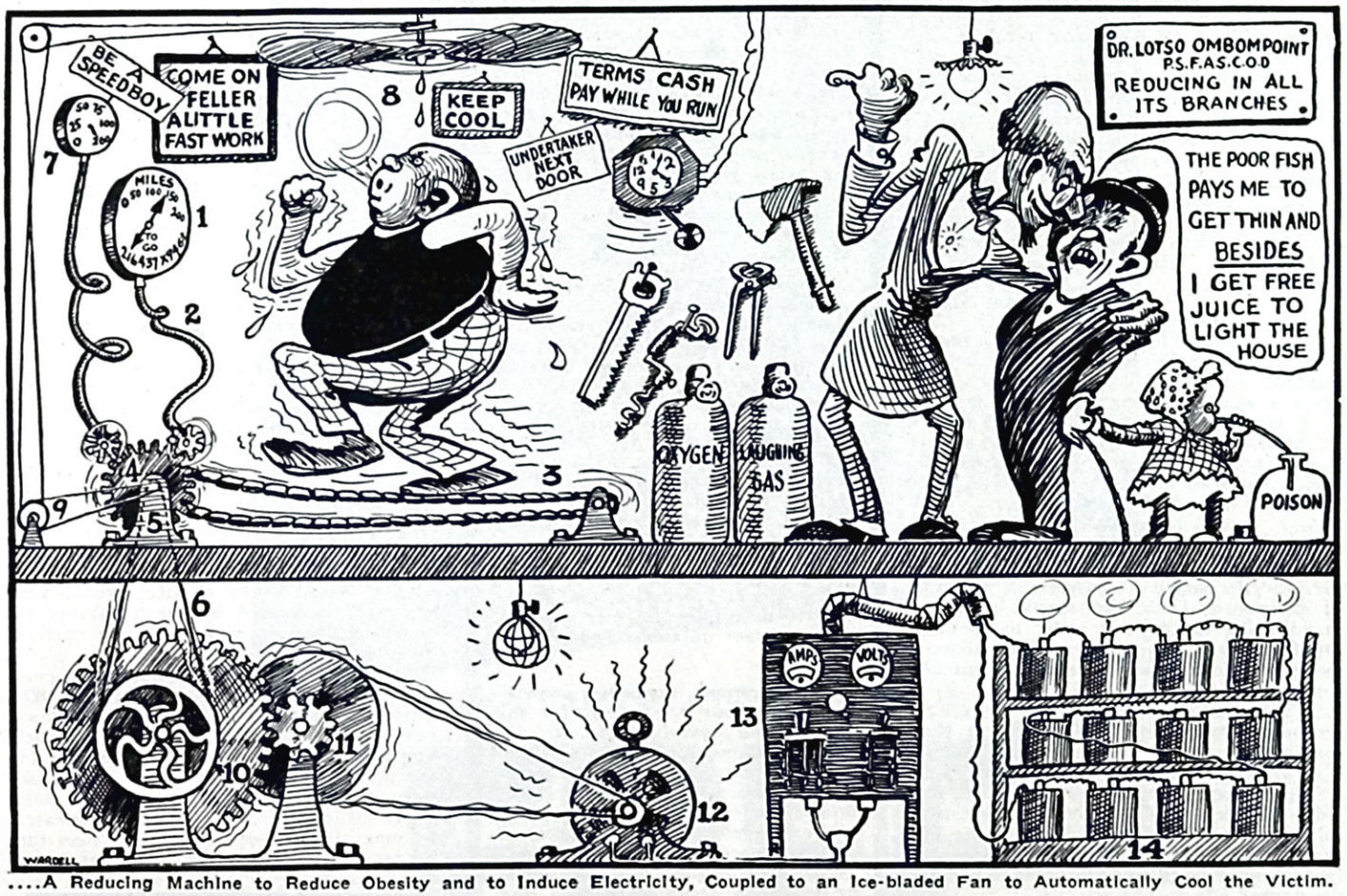
2° A reducing machine coupled to an ice-bladed fan to automatically cool the prime mover.

3° A reducing machine to reduce obesity and to induce electricity.

In commemoration thereof, I have emplaced hereunder and below my solemn chirograph and seal on this very day of February thirty-first, anno domino the nineteenth, at 5 o'clock tea, with a compound wavelength of 820° specific gravity under a barometric pressure of 1¼% Centigrade in the shade of Hades.

WILL U. CHEESIT,
By his Attorney,
J. C. McNamara,
4741 Indiana Ave.,
Chicago, Ill.

Witnesses:
H. O. Tomalé
U. Sedit.
May Onaise.


BE A SPEEDBOY
COME ON FELLER A LITTLE FAST WORK
KEEP COOL
TERMS CASH PAY WHILE YOU RUN
UNDERTAKER NEXT DOOR
DR. LOTSO OMBOMPOINT P.S.F.A.S.C.O.D REDUCING IN ALL ITS BRANCHES
THE POOR FISH PAYS ME TO GET THIN AND BESIDES I GET FREE JUICE TO LIGHT THE HOUSE
OXYGEN
LAUGHING GAS
POISON
AMPS
VOLTS
WARDELL

....A Reducing Machine to Reduce Obesity and to Induce Electricity, Coupled to an Ice-bladed Fan to Automatically Cool the Victim.

QUESTION BOX

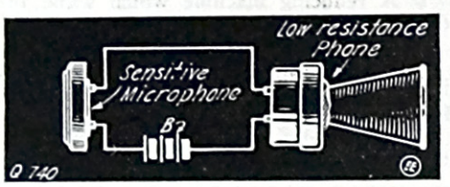
This department is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., **must** be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

LOUD SPEAKING TELEPHONE

(740.) E. P. Smith, Marysville, Ohio, writes us:

Q. 1. "I have seen demonstrators in various store windows, using a telephone transmitter to speak into, wired to a mega-



Circuits of Loud-Speaking Telephone, Comprising a Microphone and Special Low-Resistance Receiver.

phone with a loud-speaking receiver on the outside of the window. The demonstrator seems to speak to the people on the outside in an ordinary tone of voice, which can be plainly understood. Please give diagram of this outfit.

A. 1. The system used by such demonstrators is a loud-speaking telephone consisting of a special microphone connected to a low resistance telephone receiver which has about 5 ohms resistance, equipt with a metallic horn. Diagram of connections is given herewith.

RADIO QUERY.

(741.) H. G. Wilson, New Zealand, says:

Q. 1. "In the Telefunken system, the alternator frequency is 500 cycles, which gives a spark frequency of 1,000 in the H. F. circuits. The spark gaps break down at 1,000 volts. Using say, 60 gaps in series, is it possible to get one spark per half cycle with a transformer secondary voltage of only 30,000 volts?"

A. 1. It will be possible, providing that the oscillatory circuit is tuned to the condition desired. In this case it will be necessary to employ a considerable amount of inductance. Great care should be taken in adjusting the gaps in order to operate satisfactorily in conjunction with the above-mentioned voltage, and a small amount of condenser capacity.

Q. 2. Would it not be necessary to have a secondary voltage of 60,000 volts in the case cited?

A. 2. Not necessary. However, for better spark gap operating conditions 60,000 volts will be found to give superior results. When employing 60,000 volts it should be remembered that the condenser capacity must be changed in order to obtain the desired effect.

Q. 3. What books do you recomemnd to a person interested in the practical construction of a wireless station?

A. 3. There are several good books publisht on the practical construction of wireless stations, namely, "Wireless Telegraph Construction for Amateurs," by Morgan, $1.50; "Experimental Wireless Stations," by Philip Edelman; Zenneck's "Wireless Telegraphy," $4.00; "Wireless Course," by Gernsback, Lescarboura and Secor, and numerous others, all of which can be obtained from our "Book Department."

POWER FACTOR.

(742.) William Maufras, Mantua Station, Ohio, wants to know:

Q. 1. What is the *Power Factor* and how can it be found by switchboard measuring instruments?

A. 1. There are several ways of defining the power factor, but the following is the simplest, namely: the power factor is the number of *true* watts indicated by a wattmeter, divided by the *apparent* watts, the latter being the watts as measured by an ammeter and voltmeter.

$$\text{Power Factor} = \frac{\text{true power}}{\text{apparent power}}$$

It can be measured by the employment of a wattmeter, ammeter and voltmeter and using the above expression, or else it can be found directly by using a *power factor meter.*

Q. 2. Can a 2,300 voltmeter for alternating currents be had? If so, where can I obtain one; if not, how can the voltage of such a line be found?

A. 2. A 2,300 volt A. C. meter can be obtained from the Weston Electrical Instrument Works, Newark, N.J.

If you have a low volt scale A. C. voltmeter you may utilize it effectively as follows: Procure a step-down potential transformer having a primary rating of 2,300 volts and a secondary delivering an e.m.f. in the neighborhood of that corresponding to the voltmeter scale. The ratio of transformation should be accurately known in any case for such procedure. It is dependent upon the ratio of the secondary turns to the primary turns.

TO OUR FRIENDS.

Do you realize that not one day passes when we do not receive from 150 to 250 or more letters addrest to the "Question Box"? If we were to publish all the questions and their answers we would require a monthly magazine five or six times the size of The Electrical Experimenter with no other matter but questions and answers! Of late the influx of letters has become so heavy that several of our associates have been forced to discontinue important editorial work, in order to answer the mail. This we are certain you do not wish. You do not want your magazine to lower its present high standard. You want the best, the very best, and you know we never have failed you yet.

Moreover the multitude of letters are wholly unnecessary. Most of the questions we are asked every day have been answered before in the Question Box. Therefore ere you sit down to write to us, look over your back numbers and nine times out of ten you will find the answer.

We strive hard to publish only such matter as has not appeared before in our columns, and for that reason only a small fraction of queries of those received by us are actually publisht.

Kindly note, therefore, that in the future we cannot, in your own interest, answer questions by mail, free of charge.

For questions requiring immediate answer our fee is 25c. for the first ordinary question and 25c. for each additional question. We will gladly advise fee for special questions entailing considerable calculations or research. Stamped and addrest envelope should be enclosed with the queries and, moreover, any sketches accompanying them should be made on separate sheets. And please be brief.

THE EDITORS.

FASTEST TELEGRAPH OPERATORS.

(743.) Robert Willig, San Angelo, Tex., asks the name of the three fastest telegraph operators in the United States:

A. 1. The three fastest telegraph operators in the United States are the following: William Gibson, C. M. Clifford and T. S. Brickhouse.

RHEOSTAT.

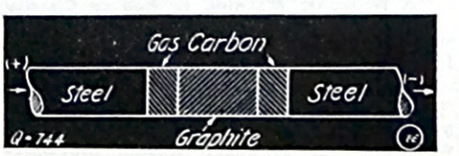
(744.) Warren L. Bald, New York, N.Y., asks:

Q. 1. Will the sketch of bottle I submit do for construction of a water rheostat to carry current of 110 volts, 50 amperes, in order to heat up the grafite-carbon-steel junction shown herewith?

A. 1. The container is far too small to carry the above current. A chamber at least two feet in diameter and two to three feet high, will be required. The electrodes should be made of iron and properly supported.

Q. 2. What degree of heat would you say will be created by the apparatus as constructed in drawing, with the current mentioned above?

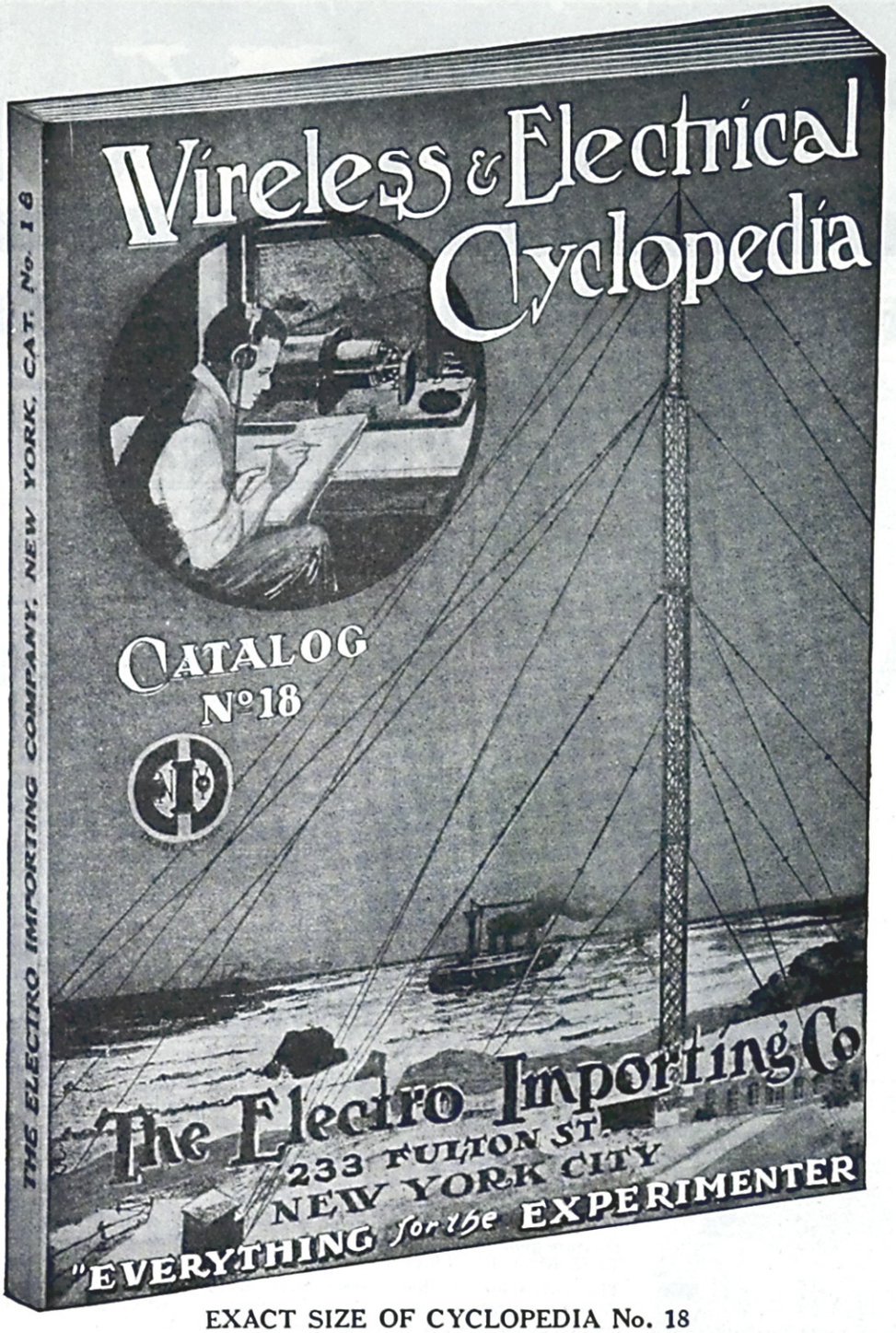
A. 2. With the above device and a current of 50 amperes a temperature of 1,800 degrees Fahrenheit can be obtained. However, it is impossible to give the exact figure, as this depends upon the size of the grafite and the gas-carbon rods, also upon their quality of hardness. A soft grade of carbon will produce a greater amount of heat per unit current than the harder variety carbon. Certain factors must



Compound Joint of Steel-Carbon-Grafite, Which, the Querist Desires to Heat Up Electrically.

be considered in this problem in order to determine exactly the intensity of heat generated by your device.

(*Continued on page 917*)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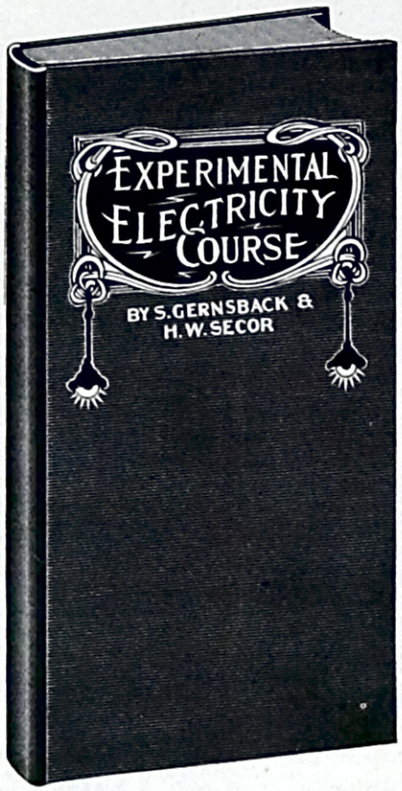

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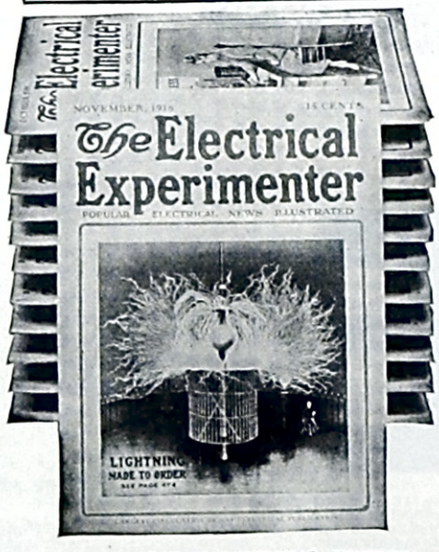

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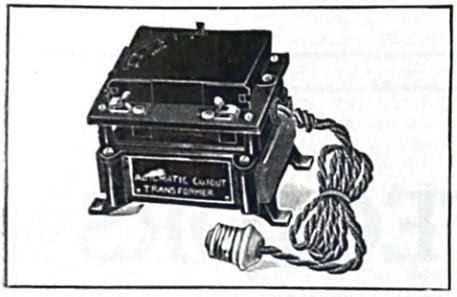
The A.C. step-down transformer illustrated is equipt with an automatic cut-out device of a new type, which shuts off the current when an overload or short-circuit occurs. The manufacturer claims that it is possible to reset the circuit-breaker while normal load is on, but it is impossible to reset the circuit-breaker while over-load is on the transformer or if there be a short-circuit on the secondary. For example: Suppose that a boy is operating a train of cars, drawn by an electric locomotive, and in turning a curve one of the cars should jump the track and fall across the third rail and outside rail, thus causing a short-circuit. The automatic cut-out of the transformer will act and open the circuit. Now suppose further that this train of cars had been operating on 20 volts when the accident happened and befo. removing the car that is across the track, the boy attempts to turn the current on again. Just as soon as the rheostat handle reaches the first contact point, which is the five volt connection, the breaker opens again, and this will continue to occur until the cause is removed, when it will be found that the circuit-breaker or cut-out can be again reset and the train will operate properly.

To mention another feature of safety, which is claimed for this device: In the operation of toys, among the younger generation, the curiosity of seeing things run fast is characteristic of their age, regardless of what harm they may do to the apparatus under operation. For instance: A motor designed for 15 volts will frequently be run on 25 volts if that voltage is obtainable, just to see the motor speed up.



New Step-Down A. C. Transformer Fitted With Automatic Circuit-Breaker to Protect It From Short Circuits or Over-Loading.

It is not necessary to state what the motor will look like after such abuse. The new automatic cut-out transformer prevents any such excess voltage being applied, as with higher voltage, excess current is past into the motor and this current is invariably greater than the limit the circuit breaker is set for, with the result that the breaker operates and opens the circuit, thereby protecting itself and also the apparatus under operation.

A NICKEL FOR THIS "SPEAKING TUBE."

In the corridor of the Telephone Building on Bloomfield Avenue, Montclair, N.J., there are two unattended public telephone coin-boxes in booths, and the cashier in the Local Commercial office adjoining is frequently asked to make change for patrons. One morning I approached an apparently bewildered person at the counter, greeted him with the usual salutation, and asked what I could do for him, says a writer in *Telephone Review;* this was his reply:

"I wonder if you would be kind enough to give me three five-cent pieces and a ten-cent piece for this quarter, as I have a desire to talk thru that speaking tube outside there."

QUESTION BOX.

(*Continued from page 914*)

ELECTRICAL PROBLEM.

(745.) John Olson, Hartford, Conn., desires to know:

Q. 1. A certain problem which I wish to have solved is given herewith: When a certain dynamo is delivering no current, it takes 1¾ horse-power to drive it. When the generator delivers 150 amperes, it takes 25 horse-power to drive the machine. Calculate the electro-motive force of the dynamo on the assumption that all of the additional power required to drive is used to maintain the current of 150 amperes.

A. 1. The voltage of the generator is 115.7 volts.

Q.2 A 40-mile telegraph line is disconnected from the ground at both ends. The line is then connected to the ground at one end, thru a 220 volt battery and a direct-reading voltmeter resistance, of which is 16,000 ohms. The voltmeter has a maximum scale deflection of 2.9 volts. What is the insulation resistance of the 40-mile line and what is the insulation resistance of one mile of the line?

A. 2. The insulating resistance of the 40-mile telegraph line is 1,197,000 ohms, while that of the one mile length is forty times that, or 47,880,000 ohms.

Q. 3. What formula can be used for measuring the resistance of a wire in which temperature is considered?

A. 3. The equation for determining the resistance of a wire and taking account of the temperature is as follows:

$$Rt=Ro\ (1+Bt)$$

WHERE:—Rt= resistance of the conductor at the temperature desired.

R.=resistance of wire at 0° C which can be obtained from any wire table.

B.=a constant and is called the temperature coefficient of resistance of the material composing the wire. This factor is also obtained from a wire table.

TRANSMITTING RANGE.

(746.) Hugh McNeigh, Memphis, Tenn., wishes to know:

Q. 1. What is the maximum transmitting range of the following set with an aerial of 4 to 6 wires—100 feet long, 75 feet high — 1 K.W transformer (flexible)—Sayville rotary gap; 1 K. W. high potential variable glass plate condenser; commercial oscillation transformer; precision hot wire meter and key?

A. 1. Under favorable weather conditions you should have no trouble in transmitting 100 miles with your transmitting outfit, providing, of course, that your oscillating circuit is properly adjusted so as to obtain maximum radiation, as noted on the hot wire ammeter.

Q. 2. I had a ¼-inch spark coil and connected one secondary to one terminal of a fancy geissler tube and put the other secondary as far away from tube as possible. I then turned the current on. A distinct gray glow in the tube was visible in the dark. I touched the unused terminal of tube and it (the tube) lit up as if the other secondary wire was being used. I found that I could attract the color by touching side of tube. What is the cause of this? I had four dry cells in the primary circuit of the coil.

A. 2. The phenomenon which you have experienced in conjunction with your geissler tube is that of the conduction of high tension electricity thru the body to the ground, which connects the negative terminal to the opposite terminal of the geissler tube, thus producing the effect you speak of.

(*Continued on page 919*)

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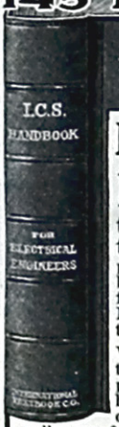

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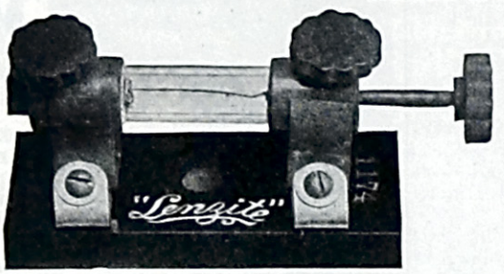
I found that the reception of signals with Lenzite as a detector quite beyond any hopes that I may have had.

Inasmuch as the mineral in question (Lenzite) seems to be "sensitive" nearly all over its surface on all sides, which is a very great advantage as it makes it almost as easy to keep in adjustment as an audion, and brings in the signals, when proper attunement is accomplished, in a very loud and positive manner, and I must add I was greatly surprised as it, without any question, has given me far greater results than any other sort of mineral detector I have tried, and I have tried to get all that I have been able to hear of.



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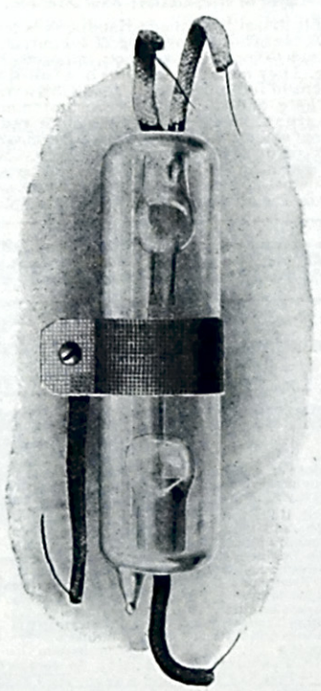

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QUESTION BOX.

(*Continued from page 917*)

RECTIFIER.

(747.) George L. Cowperthwait, Scranton, Pa., asks:

Q. 1. Is it possible for me to connect a rectifier on an A. C. circuit, so that I may use a D. C. fan motor? If not, is it possible for me to rewind my fan motor for an A. C. single phase 60 cycle circuit? If so, will you please give me an idea as to how this can be done?

A. 1. It is possible to employ a rectifier so as to convert the alternating into direct current in order to use it to run the direct current motor, providing that the motor is wound to the voltage received at the direct current mains of the rectifier. About 80 volts is usually obtained at the direct current mains.

Considerable amount of trouble will be experienced in rewinding a single phase A. C. motor. It is advisable for you to purchase a finished A. C. machine if you desire to run it direct on the line.

ELECTRICAL INSTRUMENT.

(748.) J. Thomas Johnson, Kern County, California, asks:

Q. 1. I would like to know if an electrical instrument has been invented for locating oil-bearing land or underground oil sands.

A. 1. As far as we know we have never heard or seen any instrument for locating oil-bearing land or underground oil sands.

Q. 2. Would it be within your province to give a description of the principle involved in a compass, as far as present knowledge permits?

A. 2. The general accepted theory of the compass is that of the attraction of *unlike* magnetic poles and the repulsion of *like* poles. Since the compass needle is merely a light, permanent steel magnet, pivoted on a point and acted upon by the earth's north and south magnetic poles, any variation in the earth's magnetic field is accurately shown by the movement of the compass needle. The north pole of the compass needle is really the *south* pole, since it is attracted by the earth's north magnetic pole, which as stated before is the attraction of opposite sign poles. Space does not permit us to go into further details on this subject; however, we would refer you to an excellent book on the subject by Silvanus P. Thompson entitled "Elementary Lessons in Magnetism and Electricity."

QUENCHED SPARK GAP.

(749.) Delbert Myers, Amboy, Ind., asks:

Q. 1. Must the spark chambers of a quenched gap be absolutely airtight?

A. 1. If most efficient results are to be obtained from a quenched spark gap, it is absolutely necessary to have the discharge chambers airtight; in fact it will be impossible to obtain proper quenching action of the gap if any air is present in the chamber.

Q. 2. Give the condenser capacity of the E. I. Co.'s 1 K. W. condenser for each variation, as there are four variations?

A. 2. The total capacity of the above make 1 K. W. condenser is .0203 m.f. The four sections are equally divided and each section has an electro-static capacity of .005+m.f.; the second variation is .010 m.f., the third .015 m.f., and the fourth .0203 m.f.

Q. 3. Please give the number of plates in each step?

A. 3. The first section is composed of four plates, while the other three sections are made up of five plates each.

This condenser is composed of the proper number of glass and metal plates, assembled en bloc and thoroly impregnated with a special sealing compound.

(*Continued on page 921*)

THE ORGANS OF ELECTRIC FISHES

An interesting contribution is given to *Science* by Mr. Elmer L. Shaffer, of Princeton University, on the subject of electric fishes. He says in part:

It was suggested to the writer by Professor U. Dahlgren, of Princeton University, that *Gymnotus carapus* might furnish material for the study of electric organs. Miss A. Lowrey (see *Jour. Morph.*, Vol. 24, p. 693) in her examination of several Gymnotid fishes was unable to find electric tissues. She found that

in or between the first and second muscular units of the ventral ortion of the great lateral muscles, there was a slight degeneration of parts of the muscles. The larger units had been reduced to two minute oval muscles embedded in either strands of cartilage, or strands of cartilage and fat, and occupied parts of two triangular spaces, one on each side of the median septum just above the (muscle) unit which controls the anal fin. No plates, special nerve fibers, or nerve endings were seen.

In my examination of the specimen which had been collected by Professor Dahlgren some years ago, I noticed that when the fish was scaled a portion of the body appeared almost translucent. The location of this part corresponds exactly to the location described by Miss Lowrey where "slight degeneration of parts of the muscles" had taken place. Sections were made of this portion of the body, and a study of these has shown beyond all doubt that the portion of the body in question is composed of electric tissue. Not only were the characteristic electroplaxes found, but also the special electric nerve fibers and blood-vessels supplying them.

The fish used for this study measured approximately 31 cm. in length. The body is more or less filiform, tapering to an extremely finely pointed tail. The head is flattened dorsally and the upper lip projects slightly over the lower lip. The gill opening is rather small with a dusky spot just above it. The vent opens just behind the throat. The dorsal fin is entirely lacking, while the ventral fin extends from the tip of the finely pointed tail to a position just posterior to the vent opening. The fin is controlled by a muscle unit lying just dorsal to it. The electric organs extend from the tip of the tail forward, following along the entire length of the ventral fin and lying dorsal to the muscle unit controlling the fin. There are two such organs, one on each side of the body, each tapering more or less at the cephalad and caudad ends, thus giving the organs the form of much-elongated spindles. In cross-section these electric areas appear triangular in shape and are separated by the median septum.

The electric spindles are divided into five longitudinal tiers by horizontal sheets of connective tissue running the entire length of the organ. In these tiers the electroplaxes are arranged perpendicular to the septa in compartments bounded by the electrolemma and embedded in the *electric jelly*. These compartments, with the electroplaxes lying in about the middle, are relatively large, with the result that the electroplaxes are rather widely separated. Since the strength of the electric current produced is proportional to the number of electroplaxes, it is safe to assume that the electric current produced by *G. carapus* must be extremely weak, if it is at all perceptible.

The electroplaxes are plainly seen in any section taken through the electric organ. They are more or less square or oblong in shape, with irregular projections (papillae) on the cephalad and caudad sides. These papillae are usually longer on the caudad sides. Numerous oval nuclei are arranged periferally and no cell walls are present. The core of the electroplax is homogeneous

(*Continued on page 922*)

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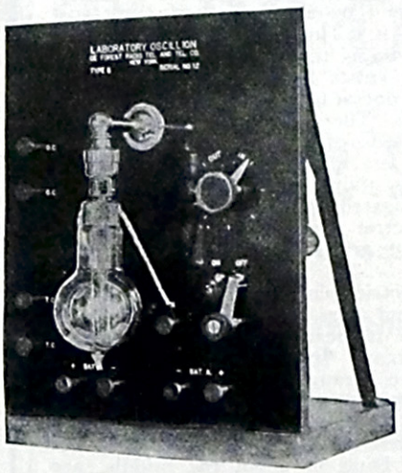

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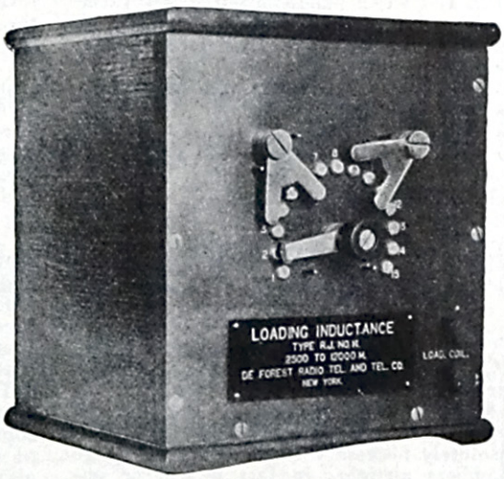

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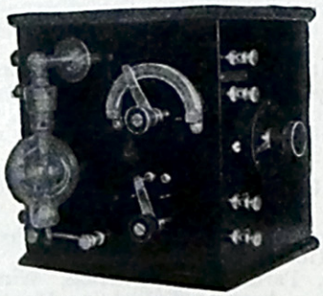

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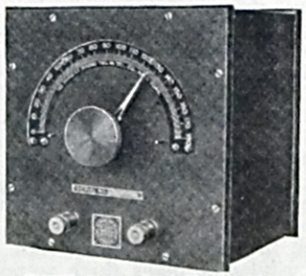

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(*continued from page 919*)

ARMATURE CORE CONSTRUCTION.

(750.) Paul Johnson, Philadelphia, Pa., writes us:

Q. 1. How is a built-up armature core constructed?

A. 1. They are made from ring sections stamped from sheet metal and are fastened to a central support or spider, which consists of an iron hub with radial spokes and a rim with provisions for fastening the rings. The rim of the spider is provided with dovetail notches into which fit similar shaped internal projections on the core segments. Each layer of the core frame is firmly held in place by end clamps. The manner of fastening the rings to the spider is an important point, for it must be done without reducing the effect of cross-section of the core, in order not to choke the magnetic flux.

Q. 2. What effect has the cross-magnetizing-force on the field of a motor?

A. 2. It tends to shift the field around in a direction opposite to that of the rotation.

Q. 3. Can you give me a concise explanation of the operation of a Thomson recording wattmeter?

A. 3. Before explaining the operation of the instrument, it should be remembered that it consists of four elements namely: (1) a motor causing rotation; (2) a dynamo providing the necessary load or drag; (3) a registering device, the function of which is to integrate the instantaneous values of the electrical energy to be measured and (4) means of regulation for light and full load. The construction of the armature and field is entirely different from that of the ordinary motor, inasmuch as no iron is used in its construction; therefore the torque of the armature is dependent upon the product of the field and armature strengths. The strength of the field, there being no iron, varies directly with the current in the field. Thus the strength of the field with 10 amperes flowing, is exactly twice the strength of the field with five amperes flowing. The strength of the armature is dependent on the voltage of the system to which it is connected, the armature element of the meter is practically a voltmeter. There is therefore a torque or pull varying directly with the strength of the armature and the field, or in other words varying directly with the watt load and except in so far as influenced by friction, the speed of rotation varies directly with the torque. The currents generated in the (drag) disc armature consist of eddy currents, which circulate within the mass of the disc.

TRANSFORMER.

(751.) Joseph Hans, Brooklyn, N.Y., desires:

Q. 1. What factors are to be considered in choosing between three phase and single phase transformers for three phase current transformation?

A. 1. No specific rule can be given regarding the selection of single or three phase transformers, since both designs are equally reliable; local conditions will generally determine which type is preferable. However, the following will be found to be helpful:

Single phase transformers are preferable where only one transformer group is installed and where the expense of a spare transformer would not be warranted. In such installations the burning out of one phase of a three phase unit, would cause considerable inconvenience for the reason that the whole transformer would neces-

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in wireless transformers is the word "Thordarson" on the maker's name-plate. There must be a mighty good reason why so many expert operators are satisfied only with a

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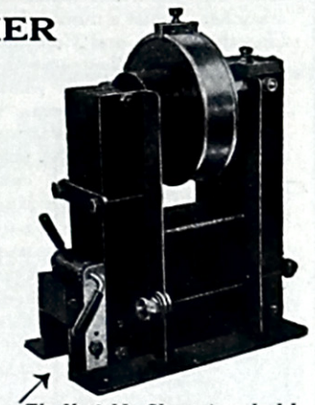

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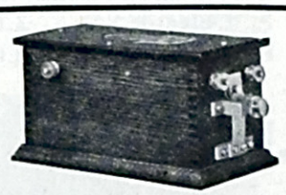

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sarily have to be disconnected from the circuit before repairs could be made.

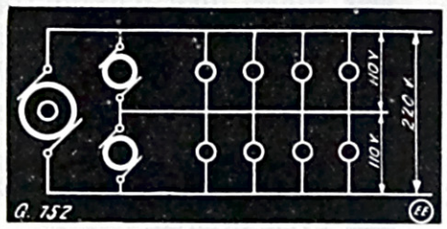
In employing three phase transformers, having both the primary and secondary connected in delta, trouble in one phase will not prevent the use of the other two phases in open delta. By short circuiting both primary and secondary of the defective phase, and cutting it out of the circuit, the magnetic flux in that section is entirely neutralized.

Q. 1. In water-cooled transformers how much cooling surface is required for an internal cooling coil?

A. 2. The surface of the cooling coil should be from one-half to 1.3 sq. in., per watt of total transformer loss, depending upon the amount of heat which the external surface of the transformer case will dissipate. For a water temperature rise of 43° Fahrenheit; 1/32 lb. of water per minute is required per kilowatt of load.

BALANCING SET.

(752.) Albert Haskell, Harrison, N.J., inquires:



How a Motor-Balancer Set Is Connected to Equalize the Voltage on Both Legs of a Three-Wire System.

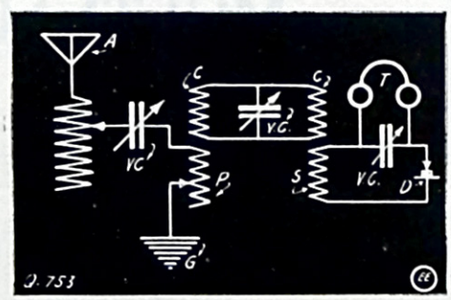
Q. 1. What does a balancing set consist of and how is it connected?

A. 1. A balancing set or balancer consists of a motor mechanically connected to a dynamo used to balance a three-wire system. The operation of such a combination is practically the same as a dynamotor and its connection is given.

When an unbalanced load comes on, the voltage on the lightly loaded side rises and on the heavily loaded side drops. The machine on the light side then takes power from the line and runs as a motor, driving the machine on the heavy side as a dynamo, supplying extra current for that side. This action tends to bring the voltage back to normal and provide good regulation.

Q. 2. How is balancing of a three-wire system accomplished?

A. 2. In practise it is impossible to obtain an exactly balanced system, as the turning on and off of lamps as required results in a preponderance of lamps in the upper or lower sets and furthermore even when the number of lamps in the two sets are equal, they may be located irregularly, thereby causing considerable currents to flow for short distances in the neutral line. Therefore, the larger the number of lamps in the circuit, the easier it will be to keep the system in a balanced condition.



Connections of Marconi Multiple Tuner With Tertiary "Energy Transfer" Circuit.

(*Continued on page 929*)

THE ORGANS OF ELECTRIC FISHES.

(*Continued from page 919*)

in appearance. The nerves and blood-vessels always approach the caudad side of the plates, a condition which is similar to that found in the electric eel and other Gymnotids.

It is thus evident that the tissue which Miss Lowrey has described as *degenerated muscle units* is really an electric organ. Her mention of "*strands of cartilage* being intermingled with the degenerated muscle leads me to believe that she has seen the electroplaxes and interpreted them as being cartilage. They are usually of a homogeneous, hyaline appearance and with their numerous nuclei might present a cartilaginous appearance. Yet their form is that so characteristic of electric plates that one can not overlook them.

Another of the Gymnotids which Miss Lowrey has examined and reported to possess no electric organs is *Eigenmannia virescens*. In the posthumous work of Sachs (1881) on *Gymnotus electricus*, some of his field notes are publisht which describe and figure portions of the body which he considered to be the electric organs of *Eigenmannia* (*Sternopygus*). It is interesting to note that his description of the macroscopic appearance of the electric organs exactly fits that of *Gymnotus carapus* presented here.

From an evolutionary standpoint the weak or pseudo-electric fishes form a subject of interesting speculation. The Gymnotids (except *Electrophorus electricus*, the electric eel) and certain of the Raiidæ possess these weak electric organs. Darwin, in his "Origin of Species" (page 167, sixth edition) has admitted that the electric organs of fishes present difficulties to his theory of natural selection. Are the weak electric organs *rudimentary*, or are they *new organs in the process of progressive development?* If they are rudimentary, why have they been discarded; if they are new organs just beginning to appear, of what selection value can they be if they produce no perceptible electric current? Only a study of the development of these organs can throw light on these questions. In certain of the Raiidæ which have been investigated it seems quite evident that the electric organs have been recently acquired and are not, therefore, the rudiments of previously existing well-developed ones.

PROFESSOR FLEMING ON LONG-DISTANCE TELEPHONY.

Prof. J. A. Fleming commenced his fifth lecture at the University College, London, on "Long-Distance Telephony" with a demonstration of the effect of loading upon the current sent into a 14-mile 44-lb. cable, and the current received at the far end. Artificial cables were employed and it was shown that on switching over from an unloaded to a loaded cable, the current at the sending end diminished but the received current very greatly increased. The high-frequency alternator used for the experiment did not yield a pure sine wave, but Prof. Fleming showed that the undesired components of the wave could be filtered out by connecting resonating circuits in shunt to the terminals, each such circuit containing a capacity and an inductance in series, such that the frequency with which it would resonate equalled $\frac{1}{2}\pi\sqrt{LC}$. By winding coils upon the inductance coils, as in a transformer, pure sinusoidal currents corresponding to the resonating harmonics could be obtained, having, for instance, frequencies of 1,000, 3,000 or 5,000 cycles per second respectively.

For the study of these high-frequency waves the Duddell oscillograph was not suitable, as its natural frequency of vibration was not sufficiently great—it should be ten times that of the wave under examination. The Braun cathode-ray oscillograph was free from this objection, but the trace obtained was not sharp enough. However, a rough practical test could be made with a condenser, voltmeter and ammeter; connecting these with the alternator, if no harmonics were present, the current I would be $= 2\pi\ n\ v\ c \times 10^{-6}$, or $10^6\ I/n\ v\ c = 2\pi = 6.28$, if, however, harmonics were present, the latter ratio would always be greater than 6.28, possibly two or three times as great. For a true sine wave it was best to use a special machine such as that designed by Mr. Duddell.

The measurement of the small alternating currents employed in telephony necessitated the construction of special instruments, usually dependent upon thermal effects. Methods of measuring small capacities were also explained. Remarking in connection with the measurement of s/c that the Postoffice engineers had discovered that gutta-percha conducted alternating currents better than direct current, Prof. Fleming described a special capacity bridge which he and his late assistant, Mr. G. B. Dyke (killed on active military service), had developed for the investigation of this effect, and showed the importance of the phenomenon in the cases of dry manila paper, gutta-percha and vulcanized rubber, all of which varied widely in conductivity for high-frequency alternating currents with the frequency and the temperature. For ordinary g.p. s/c = 100 or 120; for Siemens special g.p. s/c = 20 or 12. The value of R/L could be measured with the Hughes bridge, which the lecturer explained in detail.

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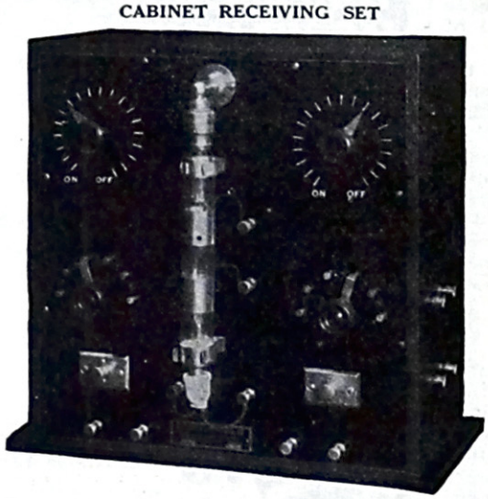
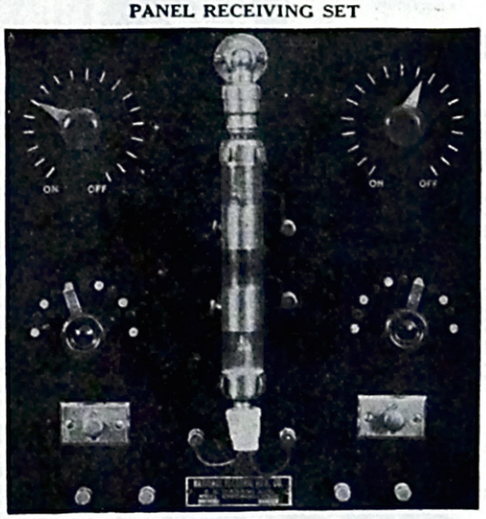


PANEL RECEIVING SET



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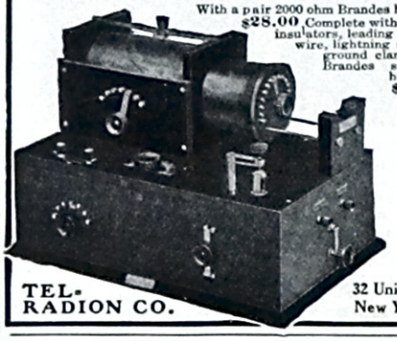

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THE WORK OF THE NAVAL CONSULTING BOARD.

The year has witnessed the perfecting of teamwork between the experts of the Navy and the outside scientific world, says Secretary of the Navy Daniels in his annual report. The Naval Consulting Board, headed by Thomas A. Edison, and composed of members selected by the leading scientific societies of the country, has rendered noteworthy service. The lack at first of any provision in law whereby the members of the board could be compensated for expenses incurred incident to their service, which they rendered willingly and with conspicuous generosity, has been remedied by the last naval act, which appropriated $25,000 for this purpose. Congress has thus been quick to secure for the Navy the aid of outside scientists, and the approbation of the President when he declared, in view of the Navy's need of preparedness, "not for war but for defense," personally to the members of the Naval Consulting Board that "We must have the cooperation of the best brains and knowledge of the country." Of the problems presented by the Navy Department for solution, some have been solved and others are in process of investigation, especially where the question involved is one subject to continuous improvement. Reports as to the value of many inventions have been received from the Naval Consulting Board, and its work has brought the officials of the Navy into closer touch with many industries.

A notable development of the board's work is its plan for the perfection of industrial preparedness thruout the country in its organization in each State of a committee, composed of one member each from the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Chemical Society, to work in connection with the committee on production, organization, manufacture, and standardization of the Naval Consulting Board. With five members in each State this committee, which is called the *committee on industrial preparedness*, consists of a total of 240 members. The District of Columbia and the Territory of Alaska also is represented on this committee. The members of this committee have been designated as State directors of the organization for industrial preparedness, and they are associate members of the Naval Consulting Board of the United States. The directors in each State have enlisted the services of all the members of the five societies named, who are designated as field aides, and who are earnestly and energetically assisting in gathering information collected in the form of an industrial inventory.

These blank inventories were sent confidentially thru the State directors and aides to manufacturing establishments of every character thruout the entire United States, and the information thus secured in answer to questions on the blanks has been confidentially filed for the use of the Government in time of national need or crisis. This information is of such a character as will allow munitions of war to be ordered and manufactured in the

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most expeditious manner and delivered in the shortest possible time. The responses to these requests for industrial information have been exceedingly gratifying, and already they have received at the central office of the committee on industrial preparedness, New York City, 24,500 inventories, and it is expected that the total number will soon reach 25,000. This means that if it were ever necessary to mobilize to defend our country against foreign aggression, at least this number of concerns might, when prepared by this Government with proper gages and drawings, be counted on at short notice to transfer the energies and machinery of industrial peace into the manufacturing of munitions of war. In other words, it means that America can never be caught off her guard with an insufficient number of shells and cartridges and other implements of defense, as was the case with some of the countries of Europe at the beginning of the present conflict.

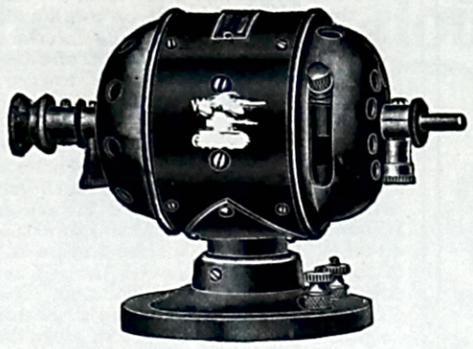
In connection with the organization of the Naval Consulting Board, Congress was asked to provide an experimental and research laboratory so as to utilize in the fullest degree the talent and genius of the civilian scientists who responded so generously to the request for their aid. The naval act of this year provides for such a laboratory by appropriating $1,500,000 for its construction. This laboratory will undertake the study of such subjects as gun erosion, torpedo motive power, the gyroscope, submarine guns, protection against submarines, torpedo and mine attack, improvement in submarine attachments, improvement and development in submarine defense, storage batteries and propulsion, aeroplanes and aircraft, improvement in radio installations, and other necessary work of this kind. The act establishing the laboratory authorizes the employment of such scientific civilian assistants as may be needed. This is a marked advance in naval development, and work done in this laboratory is expected to result in the greatest value to the Navy, especially in determining the value of new inventions, improving materials, bringing new materials into use, improving products, lessening weight, and materially decreasing the cost of operation on board ship.

DOES NEGATIVE SURFACE TENSION EXIST?

An interesting discussion on the phenomenon of negative surface tension is given by Arthur L. Kimball in *Science*, in respect to a previous note by Professor W. A. Patrick, who exprest doubt as to the existence of negative surface tension, suggesting that it can scarcely be conceived without assuming a force of repulsion instead of attraction between molecules of the liquid.

But he surely can not mean to question the existence of negative surface tension at a surface *between a liquid and solid*, says Mr. Kimball, for how otherwise are we to explain the most familiar facts in capillarity? Is it not negative surface tension which causes the water to rise in a capillary tube, or against a glass wall, and causes a drop of oil to expand indefinitely over a glass plate? Is it not the greater negative surface tension in the oil-glass surface which causes the film to expand against the contractile force, or positive surface tension of the oil-air surface?

Nor does it appear to be necessary to suppose a repulsive force between molecules of the liquid in order to account for the existence of such a negative tension, for if the resultant force of attraction on a particle of liquid near the surface, due to all particles on both sides of the surface



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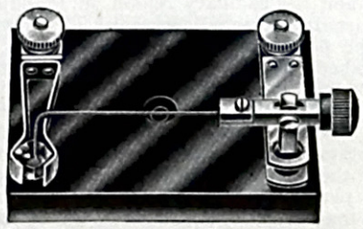

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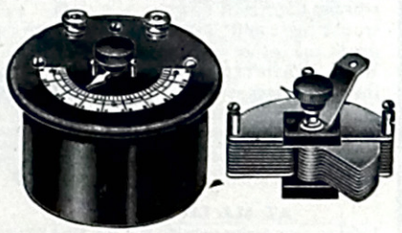

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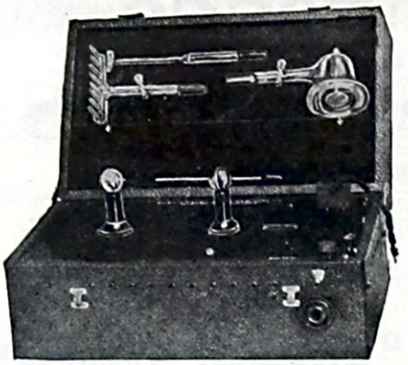

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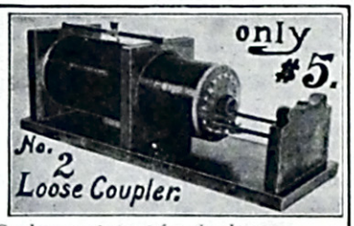

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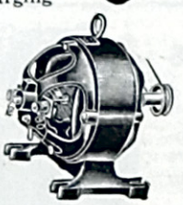

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lying within the range of sensible molecular attraction is directed away from the surface and towards the interior of the liquid, the particle will tend toward the interior and we shall have positive surface tension, but if the resultant attraction is toward the surface there will be negative surface tension.

In case of an air-liquid surface the attraction of neighboring liquid particles upon a particle in the surface is so much greater than any opposing outward attraction by adjoining air molecules that the first condition holds and the surface tension is *positive*. While at a glass-oil surface a particle of liquid near the surface may be supposed to be more strongly attracted by the neighboring glass molecules than by the oil molecules in its vicinity, in which case the resultant attraction is toward the glass, the potential energy of a liquid particle is less at the surface than in the interior of the liquid, and the surface tension is *negative*.

When liquid comes against liquid the case is complicated by the mobility of particles on both sides of the boundary. It seems probable, however, taking an oil-water surface as an example, that if the resultant attraction on an oil molecule at the surface is directed across the boundary from the oil side toward the water, that a water molecule at the surface being in the same situation with respect to the surrounding molecules will be urged in the same direction. In other words, we can hardly imagine a particle of one sort in the surface as being drawn in one direction by the attraction of all the surrounding particles on both sides of the surface, while a similarly situated particle of the other sort would be drawn in the opposite direction.

We may assume then that at a surface between two liquids, particles on one side are urged away from the surface, while those on the other side are urged toward it. That is, there are two influences, one tending to contract the surface and the other to expand it. If the first is predominant there is positive surface tension; this is the ordinary case where diffusion does not take place, as with water-oil or water-mercury.

If the second is predominant the surface tends to expand indefinitely, and the limit would seem to be reached only when one liquid is uniformly diffused thruout the other. In this case diffusion is to be expected also from the consideration that if particles in the one liquid are drawn so powerfully towards the other as to force the expansion of the second liquid in opposition to its contractile tendency, it seems probable that they will be drawn actually *into* the second liquid and thus the integrity of the surface be destroyed. We conclude, therefore, that *a positive surface tension is to be expected between all liquids that do not interdiffuse.*

If the particles in a colloid solution are to be regarded as solid, we may expect to find cases where the surface tension is positive and other cases where it is negative. Where it is positive there will be a tendency to flocculate, for as two colloid particles come together liquid particles move out from between them into the interior of the liquid and the capillary region surrounding the particles is thus decreased in volume and the potential energy of the system is diminished. When, on the other hand, the surface tension is negative at the surface of a colloid particle, there will be no flocculation, and the particles will not approach each other near enough to crowd the liquid out of the region of surface energy around either particle. This, of course, does not imply that there is any tendency in the latter case for the colloid particles to remain in equilibrium equally diffused thruout the liquid.

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SUNLIGHT AND THE MAGNETIC NEEDLE.

An interesting discussion on sunlight and the magnetic needle by F. C. Loring, department of terrestrial magnetism, Carnegie Institution, appears in a recent number of *Science*.

Mr. Loring says in part:—"The writer is directly interested in collecting ocean data on the nonmagnetic ship *Carnegie*, to be used, first, practically in constructing charts for navigation and, second, in theorizing on the causes of the earth's magnetism and on its changes. I desire to call attention to the work of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, D.C., in the making of extensive magnetic observations leading to the formation of some correct theory of the causes of the earth's magnetism.

"So far as I am aware neither Faraday in his experimental researches nor Maxwell in his mathematical treatment thereof, nor any one else recently, ever proposed or performed an experiment, excepting the experiments with polarized light, to show that a direct connection existed between light and magnetism.

"At the end of Faraday's first period of brilliant discoveries or about 1841 various investigators had performed many experiments with this end in view.

"In general these had taken the form of attempts to magnetize bodies by exposure in particular ways to different kinds of radiations; and a successful result had been more than once reported only to be proven in error on re-examination.

"Sir John Herschel was the first to indicate the true path of procedure. He wrote:

'Induction led me to conclude that a similar connection exists, and must turn up somehow or other, between the electric current and polarized light and that the plane of polarization would be deflected by magneto-electricity.'

"Faraday had already discovered the nature of this connection in 1834, but had considered his experiment a failure. In 1845 after Herschel's remark he varied the original experiment with success by placing a piece of heavy glass between the poles of an excited electro-magnet; and found that the plane of polarization of a beam of light was rotated when the beam past thru the bar of glass parallel to the magnetic lines of force composing the field. This constituted the discovery of the connection between light and magnetism.

"In 1851 Faraday wrote:

'It is not at all unlikely that if there be an *æther*, it should have other uses than simply the conveyance of radiation.'

"This sentence has been considered the origin of the electro-magnetic theory of light.

"The question which natural philosophers had never ceased to speculate on, that of the manner in which electric and magnetic influences are transmitted thru space, assumed a definite form about the middle of the Nineteenth Century and issued in a rational theory. It was at this point that the whole matter was taken up and eventually theoretically solved by Maxwell. He said:

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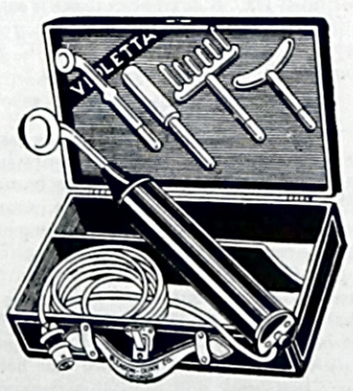

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'We can scarcely avoid the inference that light consists in the transverse undulations of the same medium which is the cause of electric and magnetic phenomena.'

"At the time Maxwell did not examine whether this relation was confirmed by experiment. For years the electro-magnetic theory was beset with difficulties and was unfavorably received by his most famous contemporaries. Helmholtz, after many years, accepted it, but Lord Kelvin, it seems, never did.

"It is quite interesting to note here that Lord Kelvin in 1904 admitted that a bar magnet rotating about an axis at right angles to its length is equivalent to a lamp emitting light of period equal to the period of rotation, giving his final judgment, however, that 'the so-called electro-magnetic theory of light has not helped us hitherto.'

"While pondering over the subject of terrestrial magnetism, electricity and magnetism on the night of Tuesday, March 7, 1916, the following thought came to me with such force that I set it down in my diary. A copy is as follows:

'I conceived the idea to try the effect of a concentrated sunlight on the magnetic needle or magnetized bar of any kind. The question being will not the concentrated light lessen or strengthen the magnetism of the magnet?'

"In performing such an experiment arrangement must be made so as to exclude the effects of the absorbed energy appearing as heat. I intended to try this as an experiment at some convenient time in the hopes that some new connection might be brought about concerning the subject of light, electricity and magnetism and their mode of propagation.

"On Saturday, March 11, 1916, four days afterwards, I chanced to see a newspaper clipping regarding some work of Professor T. J. J. See, of Mare Island, Cal. In this article Professor See proposed to explain many things, among them being 'the direct effect of sunlight on a magnetic needle, as in Nipher's experiment of 1913.' This was a complete surprise. Evidently this experiment had been tried with success by I suppose Francis E. Nipher, of Washington University, St. Louis, Mo.

"It seems to me that such an experiment would be valuable to science in many ways. The question arises as to the quantitative effect produced—if appreciable, then might we not expect or predict a change in all magnets more or less with time—especially as they are exposed to the sunlight? It is well known that magnets lose some of their magnetism during the process of aging. Might this effect be a contributing cause?

"The question as to the effect on small magnets such as in use for the determination of the earth's magnetic elements assumes some importance when considered in this regard.

"What might be the effect of the sunlight on the magnet if it were rotated about a horizontal line thru its center of mass and perpendicular to its magnetic axis? The theory of magnetization by rotation has been treated in two articles appearing recently in *Science* by Barnett.

"Aside from the foregoing it would be interesting to note the effect of *radio-active emanations* upon a magnetic needle.

"There are two well-known cases of the transformation of luminous into electrical energy, the *thermopile* and the *photo-electric cell.* However, in neither one is the transformation direct, as would be the case of *luminous energy falling upon the magnetic needle.*

"It would be interesting to see this matter investigated in the light of modern electrical theory and to know of Nipher's experiment and of the results obtained."

[We extend space in the columns of THE ELECTRICAL EXPERIMENTER to any investigator of standing who has discovered anything definite along these lines. Address all communications to the Editor.]

QUESTION BOX.

(*Continued from page 922*)

MULTIPLE TUNER.

(753.) John Fisher, Los Angeles, Calif., asks us for:

Q. 1. A diagram of connections for a Marconi multiple tuner.

A. 1. The appended diagram gives the connections of the tuner you speak of.

Q. 2. Is it possible to employ any magnetic substance in proximity to oscillating circuits as used in the undamped wave receiver?

A. 2. Not ordinarily. However, it was found that by employing three coils properly placed with a magnetic disc near by, the signal was considerably magnified. This has been developed by Mr. Ernest Mignon and his system was described at length in the March issue of this journal.

Q. 3. Where can I obtain information on the subject of wireless transmission of photographs?

A. 3. There has been publisht an excellent book describing this subject in non-technical language entitled: "Wireless Transmission of Photographs" by M. J. Martin. It can be supplied for one dollar by our "Book Department."

TRANSMISSION VOLTAGES.

(754.) Frederick Voughan, Memphis, Tenn., wants to know:

Q. 1. What are the standard voltages for alternating current transmission circuits?

A. 1. 6,600, 11,000, 22,000, 33,000, 44,000, 66,000, 88,000 volts. The amount of power to be transmitted determines, in a measure, the limit of line voltage. If the most economical voltage considered from the point of view of the line alone be somewhere in excess of 13,200 volts then step-up transformers must be employed, since the highest voltage for which standard alternators are made is 13,200 volts. In a given case the saving in conductors by using the higher voltage may be more than offset by the increased cost of transformers.

Q. 2. How are vector diagrams constructed for obtaining resultant pressures?

A. 2. On the principle of the parallelogram of forces.

Q. 3. Is it possible to change a three-phase current into a single phase?

A. 3. Yes; by the use of a phase changer.

TRANSFORMER QUERY.

(755.) Paul Motney, Little Rock, Kans., asks:

Q. 1. I have noted that transformers designed for twenty-five cycle circuits are larger and heavier than those of the same voltage and kilowatt rating which are designed for sixty cycles. Why is this?

A. 1. The low frequency circuit for the same number of turns and the same voltage magnetizes the core to higher density. Now there is a definite maximum to which it is practicable to magnetize a core; the hysteresis and eddy currents, also the magnetizing current increase very rapidly at high densities; therefore, in order to keep the magnetization within permissible limits, it is necessary to make the transformer, having the lower frequency with a greater number of turns or with a larger core. Both of these are usually done and the transformer is thus larger and heavier than would be necessary for operating at a higher frequency.

Q. 2. What is meant by *all day efficiency?*

A. 2. All day efficiency is the total output in twenty-four hours divided by the total input in this time. In ordinary lighting work, the transformers are connected to the line during the whole twenty-four

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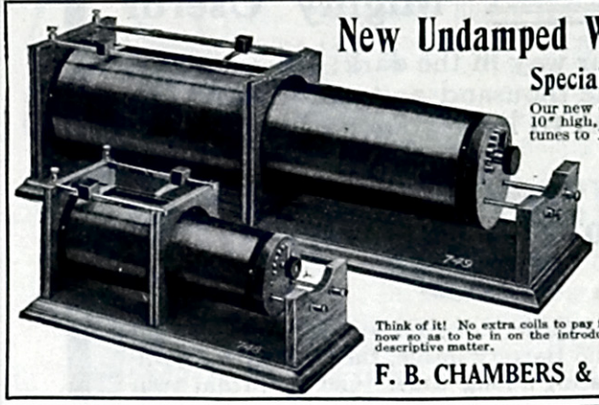

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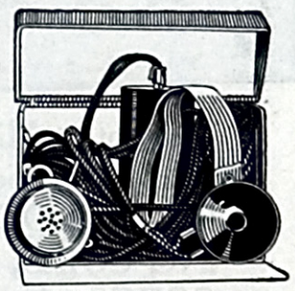

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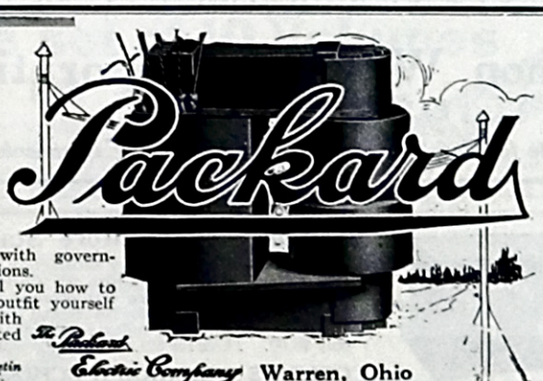

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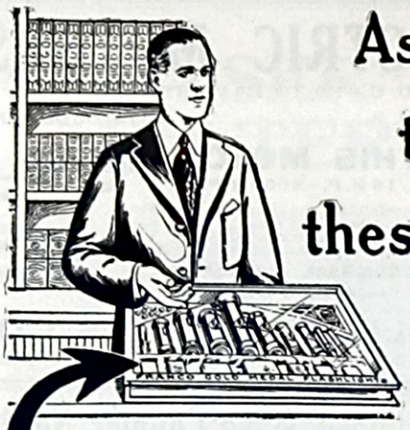

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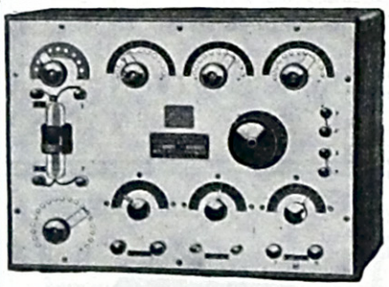

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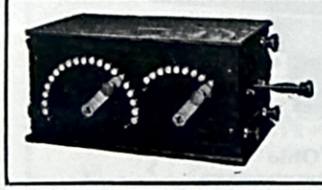

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hours of the day, while the consumers, we will assume, use the current from the transformers for five hours at full load. Since

All-day efficiency =

$$\frac{\text{Total Output}}{\text{Total Input}}$$

Which is equal to

$$\frac{\text{Full Load} \times 5}{\text{Full Load} \times 5 + \text{Core Loss} \times 24 + \text{Copper Loss} \times 5}$$

Q. 3. Why are transformer cases often corrugated?

A. 3. The corrugations increase the heat radiation surface, thus allowing the heat to be dissipated more rapidly; and secondly with a given amount of iron, a stronger case can be made.

WAVE LENGTH QUERY.

(756.) John Bowden, Grand Rapids, Mich., desires:

Q. 1. What is the wave length of my antenna which is composed of four wires, each 200 feet long and 60 feet high. The lead-in consists of a single strand, connected at the highest point making an "L" shape.

A. 1. The natural wave length of your aerial is 500 meters.

Q. 2. I desire to know how far I can receive with the following instruments; a double slide tuning coil, 500 ohm telephone receiver, fixt condenser and silicon detector?

A. 2. With favorable weather conditions you should have no trouble in detecting signals for almost 1,500 miles.

Q. 3. What instruments will I require to employ in order to be able to receive Arlington time signals?

A. 3. A good loose coupler of 2,500 meters, two variable condensers, one across the secondary of the inductive coupler, the other across the primary, 2,000 ohm radio telephone receivers and a sensitive detector such as Radiocite, Lenzite or Audion. With the above mentioned instruments you will be able to receive Arlington's time signals and other long distant stations.

ALTERNATING CURRENT LAG.

(757.) H. Coldren, Helena, Mont., wants to know:

Q. 1. What governs the amount of lag in an alternating current?

A. 1. It depends on the relative values of the various pressures in the circuit, that is upon the amount of resistance and inductance, which tends to cause lag and the amount of capacity in the line which tends to reduce lag and cause lead.

Q. 2. Does the power factor apply to capacity reactance in the same way as to inductance reactance?

A. 2. It does. The angle of lag and of lead are, from the practical standpoint, treated as if they lay in the first quadrant of a circle. Even when the negative sign of the angle occurs, it is simply used to determine whether the angle be one of lag or of lead, but in finding the value of the angle from a table, it is treated as a positive quantity.

Q. 3. What is the maximum frequency that is possible with a Vreeland mercury tube oscillator and what is its efficiency?

A. 3. 8,000 cycles was the highest frequency ever obtained with such an oscillator to our knowledge. The efficiency is extremely low; in the neighborhood of about 5 per cent.

LEMON BATTERY.

(758.) A. Vaszin, Cleveland, Ohio, writes:

Q. 1. I cannot make the "lemon" battery work, as described in a recent number of THE ELECTRICAL EXPERIMENTER.

A. 1. We do not know why you have not been successful in operating a lemon battery, but quite possibly your failure with it is due to the fact that you have been using a battery type of voltmeter, and if such is the case the lemon cell will not give indication, owing to the fact that this class of measuring instrument possess a very low resistance. Consequently they require a fairly heavy current to actuate them. It is quite necessary that you employ a high resistance laboratory type of voltmeter for this test, such as the Weston instrument.

ATMOSPHERIC CHARGES FROM AERIAL.

(759.) R. E. Mathes, Excelsior, Minn., says:

Q. 1. Why is it that I can obtain long sparks from my radio aerial and receiving instruments?

A. 1. We have known of cases where this was due to the proximity of powerful wireless stations, which would induce powerful high frequency currents in the local antenna, when the phenonemon you describe would occur.

In some cases we have known of radio operators receiving heavy shocks from their radio instruments when a thunder storm had been in the neighborhood, which caused the antenna to become heavily charged with a large amount of electricity. In some cases the electric charge from the atmosphere on such occasions will pile up or accumulate to such an extent that it will eventually jump a gap as long as one to two inches.

The editor recollects of a case where heavy static charges were accumulated on a large aerial when the sky was perfectly clear; the effect in this case being due undoubtedly to the fact that the weather was cold and the aerial of extra large proportions, which, of course, resulted in an extraordinary accumulation of static electrical energy, which manifested its presence by jumping across the aerial switch.

NEW SUSPENDED ELEVATED RAILWAY SYSTEM.

(*Continued from page 875*)

imum vertical height of main structure; the narrow gage tracks, which result in minimum weight of trucks and their connections to the car; the elimination of the heavy track floor; the use of a single central post for double track; the use of three girders for double track in place of four and the use of central trusses and smaller trucks for the cars, which reduces the cost of all the rolling stock.

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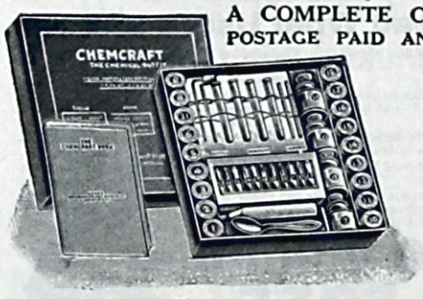

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RADIO EXPERTS TO AID U. S. IN DEFENSE PLANS.

A committee of radio engineers, which will be composed of wireless experts and scientists, is being organized to co-operate with the Government departments for national defense.

V. Ford Greaves, radio engineer, in charge of the New York wireless district, was asked by the organizers of the movement in New York to be an honorary member of the committee. Greaves accepted the membership subject to the approval of the Commissioner of Navigation.

Among the men organizing the committee are: John S. Stone, consulting radio engineer of New York and one of the leading figures in wireless telegraphy in the world; George Davis, president of the Tropical Wireless Company, and E. J. McNally, vice-president and general manager of the Marconi Wireless Company.

BUILDING A 500 WATT DIRECT CURRENT DYNAMO

(*Continued from page 900*)

if expensive wood is being used or you run short. Finish the field poles so that they will fit the slight convexity of the inside of the ring. Glue them in place. Make a pair of legs to serve as a base. (Fig. 7.)

Probably end-bells or four-arm spiders for bearings would be very desirable, but they are almost out of the question for our machine. Such a casting requires a sand-core and that in turn requires an additional pattern. Fig. 9 shows how the pattern can be easily made for the bearings. With the aid of a wood rasp and sandpaper you can shape it nicely. It is built up in rough first from wooden blocks joined and glued. Now take the field pattern and fillet the corners with a mixture of plaster of Paris and thin glue. See Fig. 7. This is necessary or the moulder would not be able to pull the pattern out of the sand without breaking all the corners off badly. For the same reason the surfaces of the pattern taper slightly. In general, make your work strictly accurate and neat, allowing no sharp corners or edges and keep in mind how the work is to be tapered. Just imagine you are the moulder and then you will make fewer errors. When the filleting is dry, finish off any roughness or irregularities with sandpaper. Then saw the pattern directly in half and join the two halves loosely with a pair of wooden dowel pins. Do this accurately. Then give the pattern a couple coats of thin shellac, colored with lampblack. Now you can turn the patterns over to a foundry and have your field and two bearing pieces cast.

Have the inside of the (casting) field poles turned out to an accurate tunnel exactly 4 1/16 inches and the bearing pieces should have 1⅛ inch holes turned in them where the bushings fit. The base has ⅜ inch holes bored for lag screws. The bearings are each held by four machine screws, ¼ inch thread. Now turn out two brass bushings that fit the shaft and are about 1 inch in diameter. They are made long enough to reach thru the bearing casting. Wrap paper around the armature till it fits in the tunnel of the field tightly. Then put on the bearings and slip the bushings in place. The space between the bushing and casting can now be babbitted in, making the bushings line up with the shaft exactly. A pulley 2½ inches in diameter and having a 2 inch face can be made from laminated pieces of oak and a metal center.

The field coils are wound on a form having a wooden core 4½x5x1¾ inches. The winding is made 1½ inches deep. Tape them well with stay-binding or cotton tape and bend the coil over a round stick of wood, so that it fits somewhere near the

curvature of the field ring when slipt in place. The coils are treated with insulating varnish and baked dry. They are held in place by four nails, driven in holes drilled on either side of the magnet cores. They are next placed and connected on the machine so that one magnet shows a *north* pole and the other *south* as indicated by a battery and compass test.

Now by driving the machine and exciting the fields with a couple of dry cells, and holding the leads of a voltmeter on the commutator, you can explore and find the neutral axis on the commutator where the brushes should touch. The highest voltmeter reading indicates the position. Now for the brushes. With machines giving over 10 volts it is an advantage to use carbon brushes. They should present an area of 1 square inch on the commutator for every 40 amperes. A brush ⅜x¾ inches with a capacity of 12 amperes will serve our use. Fig. 10 shows the brush holders and arrangement.

When your machine is all assembled, lift the brushes and magnetize the field from several dry or storage cells. Let the brushes down again and bring the speed up to 1800. Cut out all field resistance and put a voltmeter across the brushes. Watch for a reading. If it does not build up, reverse the belt. If still you do not obtain results, magnetize the field in the opposite direction. And it might be well to press hard on the brushes to lower their high resistance to the weak *building-up currents*. Adjust the field resistance so that your voltage shows 50 at rated speed. A power source of about 1 horse-power is necessary to drive it.

The author obtained alternating current from this machine by connecting a pair of slip rings to diametrically opposite points on the commutator as shown in Fig. 10. The photo shows the completed machine, which was driven successfully by a motor cycle engine.

In conclusion the writer wishes to say that no detailed method of mounting the commutator was given. The builder may fasten it on by a set screw, counter-sunk in the commutator shell, or the shaft could have been made of ⅞ inch stock; then the core could have been threaded on and the ends turned down to ⅝ inch for the bearings. While the procedure of design given here may not be engineering perfection, the writer hopes some will find an interesting and practical use of knowledge they have probably covered previously in text books.

EXPERIMENTAL CHEMISTRY.

(*Continued from page 906*)

Fig. 54 shows the structure of the flame of a candle, and it will be noticed that there are four parts to the flame. 1. The greenish-blue region at the base. 2. The dark or black non-luminous cone. 3. The Luminous cone, and 4. the Blue mantle.

EXPERIMENT NO. 45—

To show the relative temperatures of the different parts of flame apply the following tests: Have a Bunsen burner flame about 8 cm. high, and press down on the flame with a piece of paper about 5 by 7 inches, grasping the corner of the paper and pressing it down horizontally over the flame. There must be no draft of air blowing or any blowing of the flame, and several attempts may have to be made before a good result is obtained. As soon as the paper begins to burn or char, take it instantly from the flame and blow it out if the paper is burning. The paper should be forced down to within about 2 cm. of the lamp. By repeated experiments a result will finally be obtained which will show not only the horizontal structure, but also the hottest parts of the flame and those parts in which the temperature is low.

EXPERIMENT NO. 46—

The object of the following tests is to show in what parts of a flame combustion takes place. Lay for a few seconds a match stick flat across the Bunsen burner flame about 1 cm. above the top of the lamp. Observe the results (see Fig. 55).

Turn off the gas and, having run a pin thru a match 1 cm. or less from the head (which must be unburned), drop the match into the lamp, leaving the head of the match in the center and above (see Fig. 56). Now turn on the gas jet and light it far above the match. It is essential that there is no draft of air.

It will be noticed that the match does not burn. This would show that there is no combustion in the inner cone. As a match contains Potassium Chlorat or Potassium Nitrat ($KClO_3$ or KNO_3), this test does not show that the reason for non-combustion is due to the lack of oxygen. On the contrary the oxygen is contained in both the $KClO_3$ and KNO_3, but not in a gaseous state. The reason for non-combustion is due to the fact that there is neither air nor sufficient heat to cause it to ignite.

EXPERIMENT NO. 47—

Take a piece of glass tubing about 15 cm. long, draw it into a point and file and break it at the middle of the construction (do this in a similar manner as done in making the stricture tube described in the March issue, except that the glass is not bent, but pulled out straight). Insert the other end in the inner part of the Bunsen flame, near the base but not down into the lamp (see Fig. 57). Hold this steady in the left hand at an angle of about 45° and with the right hand hold a lighted match to the end and notice that the gas from the inner cone is led thru the tube and can be ignited at the end. This would also show that there is no combustion in the inner cone, because if such were the case it would be rather difficult to lead a flame thru the length of the tube, and if this could be done the flame would be noticed in the tube.

From the above experiments we can show that there are certain conditions necessary for combustion, viz., a *combustible substance* and a *supporter of combustion*. The other condition necessary is that the temperature be raised to a point at which the substance takes fire and burns (known as the *Kindling Temperature*).

EXPERIMENT NO. 48—

Obtain a block of willow charcoal and bore a slight depression near one end. Into this depression place about half a gram of Lead Oxid (Litharge) PbO. Light the flame of the Bunsen burner, about 4 cm. Practise blowing the blowpipe by applying the heat to the litharge. The flame of the blowpipe should have a nearly horizontal position, and you should be able to distinguish clearly the two parts. After you feel that you can blow the flame so that you can regulate it satisfactorily, take the charcoal in the left hand and, holding it slightly inclined, gently blow onto and against the litharge, so as not to blow away the powder, but gradually increase the strength. Continue blowing for some time, having only the inner flame on the oxid (see Fig. 61).

After having been reduced to a point where the litharge turns to a globule, remove from the flame. It will be noticed that this globule is lead. The oxygen of the lead oxid has been driven off by the application of the blowpipe heat, the reaction being as follows:

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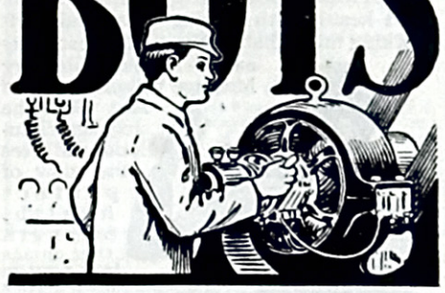

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to a given degree before they will burn. This point is called the *Kindling Temperature,* and it varies for each substance. Below this point the given substance will not burn, but at or above its kindling temperature it takes fire (even spontaneously) in the presence of a supporter of combustion. Substances may be made to burn under water, and flames may be frozen out by cooling below the kindling temperature.

To illustrate the kindling temperature more clearly we will take the following:

In making a coal fire we know that it is necessary that paper, wood and coal be burned in the order named. We could not light the coal with a match and while we may be able to light the wood, it would be impracticable. We therefore employ the easiest method, by lighting the paper, which has a very low kindling temperature, and the nadding wood, which is raised to its kindling temperature by the heat of the paper. After the wood is lighted and gives off heat, we add the coal, which in turn is ignited by the heat of the wood.

If the burning material is a good conductor of heat, as iron, the heat is conducted away so rapidly that the temperature falls below the kindling temperature and the fire goes out.

EXPERIMENT NO. 49—

Arrange the apparatus as shown by Fig. 60. Have the gas turned off and set the wire gauze 2 to 3 inches from the top of the burner. Turn on the gas and let it flow for a few seconds, then apply a light above the wire gauze.

This principle is used in the Davy's miner's lamp, and thus prevents explosions in mines which are caused by CH (*fire damp*) escaping from the coal and mixing with the air and being ignited by any flame from the lamp. This lamp is surrounded by thin mesh wire which keeps the gas outside the lamp at a point below its kindling temperature, and even tho inside the flame is burning vigorously, it will not ignite the gas. The iron wire conducts the heat off so rapidly that it does not raise to a point whereby the gas is ignited.

EXPERIMENT NO. 50—

Grasp a piece of iron (4x4 inches) gauze by one corner, and push down flat over the flame of the Bunsen burner. You will notice that the flame does not pass thru the wire gauze until the iron becomes hot enough to heat up the portions of gas above the gauze. Before repeating the experiment allow the gauze to cool, otherwise the experiment may not work. The reason that the gas does not pass thru the gauze has been explained previously; as soon as the gas below heats the gauze to a point which is the kindling temperature of the gas above, it takes fire and burns.

EXPLOSION

If a lighted match is brought close to a mixture of hydrogen and oxygen in a confined space, an *explosion* ensues. The flame brought to the edge of the mixture rapidly spreads thru the whole, and combination takes place in all parts practically at once. The great heat liberated by the sudden union of the whole volume of gas expands the product to many times its original volume, and it almost as suddenly contracts. The sudden expansion forces everything else aside, and, if the gases are confined, tends to break the confining walls, producing an explosion. In the contraction which follows, the molecules roll over each other and rush back, and thus there are two indistinguishable sounds following in rapid succession. Quick combustion in a confined space makes an explosion, if the substances are intimately mixed.

A chemical explosion involves five conditions: 1. A combustible, 2. A supporter, 3. A kindling temperature, 4. An intimate mixture, 5. A confined space.

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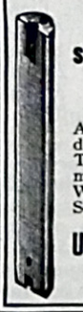

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PATENT ADVICE

Edited by H. GERNSBACK

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Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

CAMERA.

(134) Harry Lytle, Akron, Ohio, writes as follows:

"An invention that operates the camera in such a manner as to enable a person to take his own picture without using a string. My invention is controlled by sound. Do you think the scheme is patentable?"

Our correspondent also gives us further information on the device.

Answer. While the idea is a good one, we doubt very much whether it is commercially practical. There is not enough demand for such an article, we think, to have a manufacturer put it upon the market, because very few people as a rule take their own pictures. Suppose there was such a device on the market, would you be tempted to pay say from $1.00 to $3.00 apiece for an apparatus of this kind, merely to take your own picture? We do not think you would. It is one of those things which, while the idea is good, there is not sufficient demand for, to warrant patenting it.

LOOSE COUPLER.

(135) Frank McMullen, Lairchance, Pa., says: "Is the enclosed hook-up for switches and location of secondaries new, and could a patent be obtained on them?" The device is a loose coupler having twin secondaries.

Answer. Nothing new seems to be presented in the device except a certain phase of the switching arrangement, and we doubt very much whether, even tho a patent could be obtained on the switching arrangement, such a patent would be worth much to the maker. Twin loose couplers of this kind have been described years ago in *Modern Electrics* and THE ELECTRICAL EXPERIMENTER, and therefore nothing new is contained in at least this phase of it.

TELE-TRANSMISSION.

(136) R. K. G., Clay City, Ind., writes to us as follows:

"I am sending plan of my instrument by which geometric figures, pictures, newspaper prints, letters, etc., can be sent by wireless. It is based on Electrolysis. Is this idea practical? Would it pay to have it patented?

Our correspondent furthermore says he has a way to send photographs, also a new method by which a person at one end of a line would be able to see the person at the other end!

Answer. In the description and drawings submitted, nothing new is presented. The method of sending pictures by Electrolysis is at least seventy years old, and the difficult part in order to transmit pictures and drawings correctly is due to the fact that it is almost impossible to obtain complete synchronism at both ends of the line at all times. Usually there is what is known as *distortion*, which very frequently happens with the best machines of this sort.

As for the last idea, namely *tele-transmission*, so far we have not seen anything that really would work, and if our correspondent really has such an instrument, he had better take it to the Patent Office without much delay, as it is probably one of the greatest inventions of the century.

ANTENNA CONNECTOR.

(137) Nicholas Maynard, Sabetha, Kans., has submitted to us a rather novel antenna connector, which does away with soldering and other difficulties in connecting aerial wires as well as lead-in rat-tails. Only two screws are used on the device, which is light and simple of construction. Our advice is asked on it.

Answer. It is an excellent idea and we think it is worth patenting. This article does not seem to rust connections, and it appears that good contact should be readily had at all times, which is an important factor in antenna connectors. We would advise our correspondent to get in touch with a patent attorney.

MOVABLE AUTO HEADLIGHTS.

(138.) Howard J. Heim, Dawson, Neb writes:

"I wonder how many motorists in turning corners at night know of the danger which exists on the other side of that corner. The bright shaft of light from the headlights sent out straight ahead, only intensifies the darkness at the side into which the car runs. Why not turn the headlights so that they will point in the direction the car is going. Am enclosing drawing which explains the idea. Would appreciate your opinion as to its practicability and whether it is enough so, that it would be commercially valuable if patented?"

Ans. A similar device to this is on the market already and by looking up any catalog of a large automobile accessories company, the moving headlights will be found listed. We saw such headlights for the first time about eight years ago, but somehow or other they do not seem to be a success.

ELECTRIC APPLIANCE.

(139.) Joe Street, Los Angeles, Calif., sends us specifications and drawings of an

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electrical appliance in the form of a cord adapter. He states that almost everyone has several appliances to be attached to lamp cords, and with this device the extension can be turned in a moment's notice into an extension cord which is very handy to have around the house at all times. Our advice is asked on the invention.

Ans. The idea seems to have some rather good and novel points and we think there is a possibility of obtaining a patent on it. There seems to be a commercial possibility for the device in our opinion.

AUTO ACCESSORY.

(140.) Ernest Rerucha, Brainard, Neb., writes:

"I have worked out an idea of a signal dummy for automobiles of which I am enclosing sketch for your inspection. Will you kindly advise if the device could be patented and if it would pay to patent it. The idea is to have a dummy fastened to the radiator cap and the device is to close the circuit to the horn of the car while its hand is holding a trumpet to its mouth which would make it seem as if the dummy made the noise."

Ans. We do not see the usefulness of this idea, and at best it is nothing but a novelty which we hardly think would prove a commercial success. While a Design Patent may be obtained upon it, we think our correspondent will find it rather hard to dispose of the patent.

TYPEWRITER ATTACHMENT.

(141.) Walter G. Johnson, Salem, Neb., writes us:

"I wish to submit for your consideration an idea and ask your advice upon it as a patentable article. I wish to put a small inexpensive attachment on the typewriter to return the carriage automatically when the end of a line is reached. Such a device would save time and the necessity of removing the fingers from the keys so often. It would operate with a spring and therefore would be inexpensive."

Ans. The idea is as good as it is old. Nothing new is contained in it save that no one has been able to turn out a device that would stand up under all circumstances and which could be incorporated readily in any typewriter. There is no doubt that there is a large and insistent demand for a device of this kind, and a good attachment of this sort would certainly be worth a great deal to the inventor.

POCKET ELECTRIC FLASHLIGHT.

(142.) Ansley Newman, Buffalo, N.Y., wishes our opinion as to patentability and commercial value of a pocket electric flashlight combined with a cigarette case. He claims that standard flashlight parts would be available and thinks it could be manufactured at the price of an ordinary flashlight.

Ans. The idea is not new nor does there exist a great demand for an article of this kind. We do not think that a patent could be obtained upon the article.

ELECTRIC FIXTURE.

(143.) Willard Allphin, Portland, Ore., has sent us in a sketch of a certain electric fixture and states:

"Recently I tried to purchase a certain fixture like the one in the drawing submitted, and was told, to my surprise that there was no such thing on the market. I wish to know if a similar fixture has ever been patented and if you think it is practical."

Ans. While this fixture shows some novel points, we hardly think it is patentable, as there are very similar articles on the market which do the work. However, you might get in touch with a patent attorney for further advice and search for patentability.

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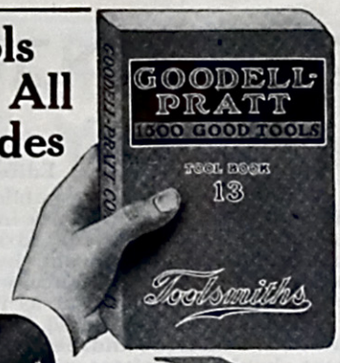

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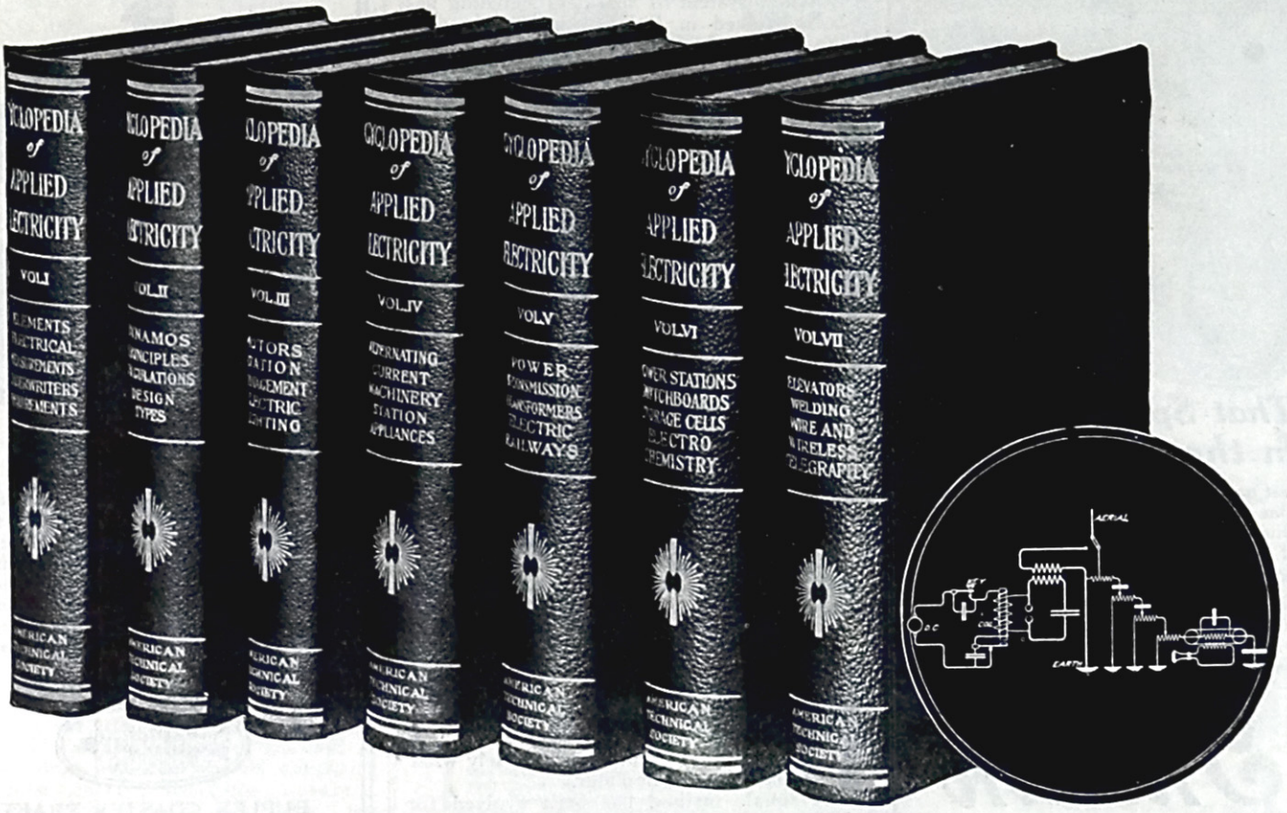

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NEW SPARKLESS SIGNAL.

A new system of sparkless signaling has been evolved in England to comply with the Home Office requirements. The bell is of the solenoid type, into which a simple, but at the same time very important, improvement has been recently introduced, so as to enable the bell to be put in service on an alternating current supply of any voltage. The device consists of the provision of an elongated slot in the gong standard for the rough adjustment, and a quadrant on the gong base for the fine adjustment. This provision enables the relative position of the gong and tapper to be varied in accordance with the voltage passing on the circuit.

For below-ground signals a tremulous bell is a *sine qua non*, and as hitherto it had not been found possible to obtain this tremulous action with the solenoid bell worked off a direct current supply, it became necessary to devise a means to accomplish this purpose, the makers wisely determining to retain the solenoid action. The solenoid is not only the simplest, but also the safest form of electric bell. The danger with the ordinary bell lies, of course, in the self-induction set up by the amount of iron used in the coils. The solenoid does not require the same amount of protection, owing to the iron plunger being less in diameter and shorter in proportion to the size of the coil; further, the plunger is movable, and does not occupy the whole number of turns wound on the coil, which to all intents and purposes is precisely what the Home Office stipulates.

A simple method has been evolved for imparting the necessary tremulous action to the bell. The high-induction relay is, perhaps, best described as a tremulous relay, which, by means of a long spring, makes the trembler contact. The sparks which would form at the contact points are damped in the condensers, the relay having a non-inductive winding. This damping of the sparks in the relay is a provision which will be grealy appreciated by mining electrical engineers, to whom sparking contacts are a constant source of trouble.

From the foregoing it will be seen that from the wires right thru to the bell there is no possibility of sparking. The relay is contained in a stout cast-iron case, the cover-joints having broad machined faces. The cover is secured by three bolts and a lock hasp, which is past thru a square hole, preventing the cover being turned on the lock bolt, even tho the other three bolts are removed. The containing case, however, may be regarded as merely a protection to the relay mechanism, as it is clearly not necessary to the factor of safety. The bell circuit is entirely distinct from the signalling lines. In the installation inspected this was worked off a twelve-volt supply, and the line or relay circuit from a four-volt supply.

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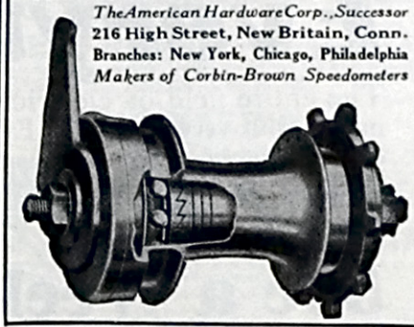

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NEW AUTOMATIC ELECTRIC BUOY NEVER FAILS.

(*Continued from page 871*)

in operation, the front of the float being partly removed to show the mechanism. For better explanation it is shown here with open gears, while the same would actually be encased and running in oil or grease similar to the generally known bench grinders, in which one turn of the handle causes 16 to 20 revolutions of the emery wheel.

A gas-buoy requires to be re-filled with fuel every few weeks or months, with frequent replacing of broken mantles and burners and the lamp cannot be closed air or water tight as it must have air-circulation. Furthermore they require a special sensitive flasher to save fuel and often also a special clockwork which prevents the burning of the light during daytime, etc.

This automatic electric light buoy is so simple that it can be made for a fraction of the cost of a gas-buoy and after it has once been anchored in water it does not require any further attention for years its inventor claims. The water will develop the electric current, the few gears run in oil or grease, and the life of the lamp is practically unlimited.

We may hope to see such buoys soon distributed all over the world and it is a poetic idea that the same water which endangers the life and safety at sea will at the same time with the help of electricity and human genius contribute to safety. The more a gale rocks the buoy, the stronger the warning light.

THE AUTOMATIC RESTAURANT.

(*Continued from page 872*)

operandi of obtaining just one cup of coffee. To begin with you advance on the unsuspecting electrical coffee dispenser—place a cup under the nozzle—drop a nickel (Tip—slugs won't work it) in the slot and turn the knob beside it. In two seconds a stream of coffee, including the cream, issues from the spout and *just* fills the cup. The front and rear of the coffee dispensing machine are illustrated here, with a patron in the act of obtaining a cup of coffee—or it may be tea or chocolate. Black coffee, too, is available.

These machines proved to be one of the most difficult of developing, owing to the fact that liquids had to be handled and moreovoer they must be kept hot *continually*. When the patron inserts a nickel in the mechanism, the electrical dispensing apparatus immediately gets busy. A powerful electro-magnet sucks up an iron piston, which is linked mechanically with the coffee and cream tanks, the mechanism being so accurately built that for each nickel inserted in the coin mechanism, the machine releases from its hot coffee and (cold) cream tanks just a sufficient quantity to fill a cup. Sugar is available on all tables and the patron sweetens the drink to suit his (or her) particular fancy.

Before going further it should be explained that a special kitchen staff keeps the food cylinders (each cylinder contains several similar compartments) and liquid tanks always full. A suitable space extends along the entire length of machines for the maintenance staff. Several men are constantly on duty in the restaurant proper, collecting soiled dishes, rearranging chairs, etc.

Of course you would not always want baked beans, a sandwich or a piece of pie and cup of coffee. For those epicures whose appetites rise beyond these or simi-

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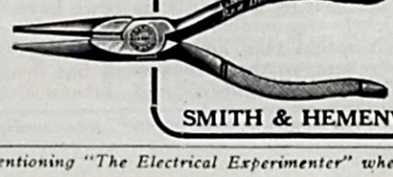

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lar limitations, there is available the *special order* board. The two illustrations herewith show the front and rear of this ingenious electrical garçon.

The front of this panel carries several dozen labels—"Hamburger steak," "country sausage," "pork chops," "roast beef," etc., etc. Suppose you decide on "pork chops." Possibly this is labeled "four nickels." You proceed to deposit the required four coins in the convenient slot corresponding to the dish ordered. When the last coin has been deposited two things happen—a tiny electric flashlight on the rear of the board lights up just over a small sign reading "pork chops." The chef notes the dish ordered and immediately starts cooking it. In front of the panel there is a special slot, thru which a *receipt slug* issues. This slug is labeled with a letter such as A, B, C, etc., the letter corresponding to a certain glass oven, of which there are several on either side of the special order board. Suppose your receipt slug calls for oven "E." When the chops are ready the chef places them in oven "E." You then insert the slug in the slot beside the proper oven and a turn of the knob releases the glass door, enabling you to reach in and remove the victuals. Bread and butter are served with most of the special orders. Knives, forks and spoons are placed on a ledge or shelf running along the front of the machines. If the dishes served in a certain section require spoons only, then nothing but spoons are placed on the service shelf. Of course if you simply must eat your peas with a knife or your ice cream with a fork—why, you can readily obtain a knife. Oui monsieur! The French is ours; the machines have not been cultivated to reply in any language as yet. Can you imagine what would happen in the rush hour if the record ever slipt!

Besides the many electrical features of the Automat serving machines, there are a number of the interesting sidelights which the outsider never sees. Think for a moment of the thousands of soiled dishes to be washed every hour. The attendants collecting these dishes from the tables bring them to a convenient and specially devised dumb-waiter, which shoots them basement-ward. Here a husky member of the dish-washer's brigade takes charge of the basket of soiled dishes and places them on the runway approaching the electrically operated dishwasher. The latter comprises two tanks about three feet apart. The basket of soiled dishes is hooked onto the chain extending from the crane arm (see photograph), and as soon as the motor is thrown on the basket is rapidly oscillated up and down in the first tank containing warm water and soap. After several oscillations in this tank, the basket of dishes is swung over to the second tank, containing hot water and thru which steam is forced. This terrific scalding thoroly cleanses the dishes after a few oscillations of the basket and by the time they are lifted out of the tank the hot water has evaporated, leaving them perfectly dry—towels are never used. A similar process is used for washing the cups which are washed separately. Result: No Greasy Cups!

You possibly have wondered how ice cream could be left standing in the service compartments, in full view for hours. Here's the secret. Those compartments are frigidly cold, and maintained so by a pipe running thru it, connected to an electrically driven refrigerating machine. On the other hand the hot dishes are kept so by steam pipes.

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EXPERIMENTAL PHYSICS.

(*Continued from page 887*)

position, insert a rubber stopper D, with a piece of glass tubing C in it, having a nozzle at the end E. B is a piece of rubber tubing and A a pinch cock. The thumb and forefinger may be substituted for the pinch cock. As soon as the tube B is placed in the jar S and the pinch cock released the water rushes in in the form of a fountain. This phenomenon is explained by the fact that ammonia gas is highly soluble in water and hence as some of the ammonia dissolves more and more water rushes in to take its place.

All of these experiments are easily explained by the Molecular Theory of Matter and the Kinetic Theory of Gases. We accept these theories because they explain phenomena for us satisfactorily, while many phenomena cannot be explained by any other theory. Briefly they may be stated thusly:

(*Molecular theory*)—The fact that gases can be comprest, and that one substance can be dissolved in another leads us to believe that space is not entirely filled by the matter of which a substance is composed; that is, the particles of matter do not really touch each other. These particles are called molecules and they are the smallest parts into which a body can be divided without destroying the substance as such. Molecules are so small that they cannot be seen even by the most powerful microscopes, but they manifest themselves to us by their behavior. Lord Kelvin calculated their size in some substances (they vary in size for different substances) and he found that if a football full of water were magnified to the size of the earth, the molecules of the water would occupy spaces intermediate in size between buck shot and footballs. The *Kinetic theory* states that the molecules of all bodies are in rapid motion and the three states of matter may be considered as the result of the various kinds of motion of the molecules and their relative velocities. In solids, the motion of a molecule is restricted to a limited space and its position with respect to the other molecules is relatively fixt. Hence the solid retains its shape. In liquids the molecule is free to move in any direction, *i.e.*, it can glide over the other molecules and the liquid will take the shape of the containing vessel. In gases the molecule has a very high speed and moves in a straight line until it comes in contact with another molecule, or with the containing vessel's walls. Because of this high speed a gas cannot be kept in an open vessel, for no matter how small or how large the vessel, and no matter how small the quantity of gas, it will always fill the vessel in which it is confined. In accordance with this theory, heat is nothing but a motion of the molecules of a substance. Pressure is simply due to the bombardment of the molecules of a gas against the sides of the containing vessel. Thus when we compress a gas we have more molecules in the original space and the bombardment is greater, and hence the gas rises in temperature and its pressure becomes greater in accordance with *Boyle's Law.*

EXPERIMENT 18—

Open a bottle of ammonia water and stand off at a distance. In a short time the fumes of ammonia gas will reach you. This is easily explained by our theory. The gas being left in an open vessel, its molecules move off to fill the room and sooner or later reach us.

EXPERIMENT 19—

Pour a little alcohol or ether in a saucer. In a short time the alcohol or ether disappears. Here we have the case of the molecules of a liquid moving rapidly enough, so that in a short time they have left the original space. In Experiment 11 we saw how water (a liquid) was changed into steam (a gas) by heating. This is also in accordance with our theory, since heat and motion of molecules being identical, by applying heat to the water we caused its molecules to move faster and finally fast enough for them to leave the original space.

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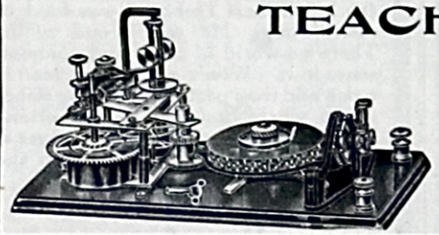

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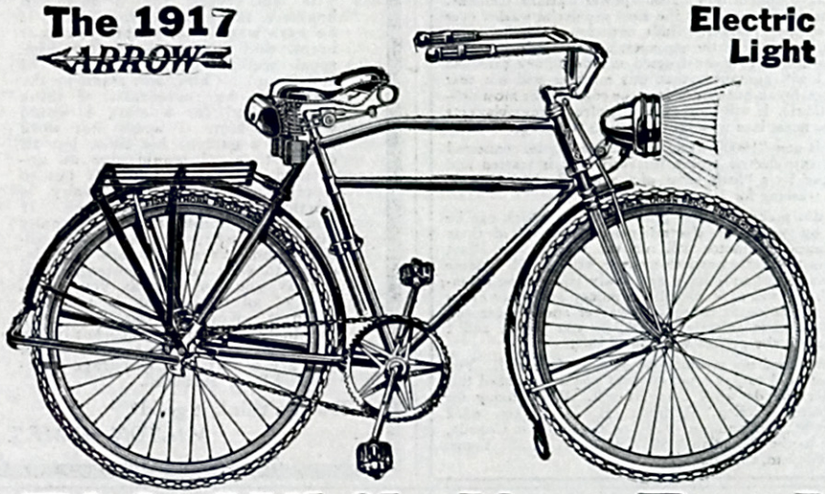

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I also make a lighter power machine which can be run by water or electric power. On all of these machines the motor will run the wringer too. Just feed in the clothes and this power wringer will squeeze the water out so quickly and easily you will be astonished. It will save 50% time, money and labor every week. The outfit consists of washer and wringer and either electric or water motor, as you prefer, and I guarantee the perfect working of each.

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EXPERIMENT 20—

Fill a test tube about half full of water and mark the level with a rubber band. Do the same with alcohol in another test tube. Now very carefully pour the alcohol into the test tube containing the water and shake vigorously. If enough of the mixture is poured into the other test tube to reach the mark we find that the mixture occupies less space than the two original liquids did. There is nothing remarkable about this when considered from the molecular standpoint. For example, we might have a quart basket containing a quart of potatoes and another quart basket containing a quart of peas. It is easily seen that some of the peas will fill the spaces between the potatoes and that on mixing together we will not have two quarts, *but less.* This is identically what happened in the case of the water and alcohol. Some of the molecules of the alcohol went into the spaces between the molecules of the water. Actually, the space between the molecules of a gas are considered to be larger than the molecules themselves.

EXPERIMENT 21—

Place some alcohol or ether on the hand and notice the cooling sensation. The *Kinetic theory* furnishes a very simple explanation of this cooling effect. When a liquid is evaporating some of its molecules are leaving its surface and naturally the most rapidly moving ones are leaving. By the continual loss of the most rapidly moving molecules the average speed of the molecules of the liquid is becoming less and less and hence *since the average speed of the molecules determines the temperature,* the temperature gradually falls and we feel the cooling sensation.

(This subject will be continued in the next lesson.)

"WITH THE AD-MAN"

(Mr. Hymes' last message)

I want you to read a paragraph that the late Elbert Hubbard was fond of distributing. He was proud of it. There's a world of truth and common sense in it. Won't you please read it twice and than paste the clipping somewhere where you can see it often? Not that you need it, but I'll wager if you believe in it you will go up the ladder faster.

Elbert Hubbard called it

Horse Sense

If you work for a man, in heaven's name work for him. If he pays wages that supply you your bread and butter, work for him, speak well of him, think well of him, stand by him, and stand by the institution he represents. I think if I worked for a man, I would work for him. I would not work for him a part of his time, but all of his time. I would give an undivided service or none. If put to a pinch, an ounce of loyalty is worth a pound of cleverness. If you vilify, condemn and eternally disparage, why, resign your position, and when you are outside, damn to your heart's content. But, I pray you, so long as you are a part of an institution, do not condemn it. Not that you will injure the institution—not that—but when you disparage the concern of which you are a part, you disparage yourself.—Elbert Hubbard.

Do you think it good?

MILTON HYMES.

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THE WASHINGTON'S BIRTHDAY RELAY AND THE Q. R. M. LEAGUE OF AMERICA.

(Continued from page 888)

wireless message across the Rocky Mountains from old KPJ, San Pedro, and delivered it in Denver. A letter from the Marconi operator on the steamship *Columbian,* while en route to Chile, says: "Your signals were easily read for three nights while making tests with your stations. The last night out this steamship was over 1,800 miles from Denver. They were not lacking in enthusiasm, however, as the sinking of the ill-fated *Republic* in January, 1909, and the famous wireless rescue of over 1,500 persons, served to awaken the Denver amateurs to the possibilities of the new art.

You will see in this magazine shortly the results of the Relay, elsewhere we show a picture of the large silver trophy which the author will donate to the most efficient and best equipt wireless amateur station in the United States. This does not mean that your apparatus must be high grade, but it does mean that it must be efficient, properly arranged, and that your station is popular because it is not black-listed on account of continually causing Q. R. M.

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TRADE—¼ H.P. 133 or 125 cycle A. C. Motor for Audion, Audiotron, or Transmitting Apparatus. H. C. Ross, 1087 Schilbi St., Columbus, Ohio.

FOR SALE—4 Kingston Auto Coils 25c each; little Hustler Motor, 40c; seven 25c books, 20c each; one carbon Transmitter, 50c; Ithaca 10 gauge double shot gun, $11; have some coil boxes and master coil cheap. Edgar Lerew, York Springs, Pa.

FOR SALE—Complete wireless transmitting and receiving set in good condition, price $10. Donald Shoemaker, Laketon, Ind.

WANTED—Tape register stock ticker, cash only. J. H. Newton, Suffolk, Va.

FOR SALE—Two 6 volt 14 ampere "Electro" Generators, never used. Sacrifice, $10.00. Ned Valeri, 388 St. Mark's Ave., Brooklyn, N.Y.

FOR SALE—Murdock coupler, fixed condenser and 1000 ohm phone with head band and cord; cat whisker; detector; variable condenser. Cost $21, sell for $10. Maurice Mc Cune, 1404 Homewood Ave., Pittsburgh, Pa.

SALE OR EXCHANGE—3 K.W. key, Brandes Superiors, Duck $2.25 Detector, Cabinet Coupler, 4 pounds No. 14 Alumium, 2 Marconi bushings, Switches, etc. H. H. Lee, 956 Water St., Port Huron, Mich.

WILL SWAP—Brandes Phones, $11; RJ4 De Forest Audion, $12; Thordarson 1 K. W., $19; 1-16 H.P. Universal Motor, $4; Eveready 4 V. 40 A. Storage Battery, $8; ½ K.W. mounted Packard Transformer, $8. Wilson Smith, S. Wayne St., St. Marys, Ohio.

EXCHANGE—Gray & Davis Ford Starter $30 cash. Want electrical, mechanical books for nice guitar. Oliver Estill, Glasgow, Mo.

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FOR SALE—$40 Course in Meter Engineering, $5; also Telephone, Receivers, Inductance coils, Pressure Gauges, Marble Base Knife Switch, Drill books. Send for list. Jean Eiler, 125 North Harvey Ave., Oak Park, Ill.

NAVY TYPE COUPLERS, 4000 meter, $6.50; 2000 meter, $5; 200 meter, 75c; Murdock variable, $2.40; Cylindrical plate variable, $1.90; Audiotron detector, $12; Brandes phones, $3.75; 2 inch spark coil, $5.50; 1 inch spark coil without vibrator, $1.25; Oscillation transformer, $1.25; Desk Telephone, $4 50; B-flat cornet, $4.50. Rule D. Egbert, Tiffin, Ohio.

TREMENDOUS WIRELESS BARGAINS—Here is your opportunity to secure first class wireless apparatus at real bargain prices. Everything absolutely as represented. 5 K.W. type E. Clapp-Eastham transformer; four variations of power; not in case. Rubber switch panel is cracked, also rubber secondary posts. Transformer is in excellent working condition. Cost $262. Special sale price $35. 5 K.W. type E. Clapp-Eastham transformer in case; four variations of power. One of secondary coils burned out which has to be removed and new one put in its place. Otherwise in splendid condition. Cost $262. Special sale price (a big bargain), $10. 3 Clapp-Eastham glass plate condensers in cases. Each case over 2 K.W. capacity. Good as new. 22 condenser sections to each case. Cost each $55. Special sale price per case of 22 sections, $13. 5 K.W. Clapp-Eastham oscillation transformer, helix style. Genuine copper edgewise wound strip. Primary has 8 turns and secondary 13 turns. Insulated on rubber posts almost 18 inches in height and 2 inches in diameter. In splendid condition. Cost $50. Special sale price, $12. 5 K.W. Clapp-Eastham straight spark gap in case. Has brand new zinc alloy sparking points. Cost $60. Special sale price, $5. 5 K.W. Clapp-Eastham Antenna Switch. Good as new. Cost $20. Special sale price, $5. Clapp-Eastham receiving set. Loose coupler made of hard rubber mounted in polished cabinet. Mineral detector on top with large variable condensers on each side, but inside cabinet. Adjusting knobs in front. Primary and secondary of coupler has sliders. No cheap construction. In splendid condition. Special sale price, $14. Clapp-Eastham receiving set. Loose coupler mounted on top of case. Has two ferron detectors and large variable condenser on each side of detectors. Primary and secondary of coupler has sliders. Splendid condition. Special sale price, $11. "Electrose" insulators, 10½ inches in length. Same as used by commercial stations. Cost each 50c. Special sale price, each, 20c. Purchaser to pay freight or express charges. Positively no trades. Remit by money order only. Checks not accepted. Order quick. Sydney Friedrich, 350 East Commerce Street, San Antonio, Texas.

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SELL OR TRADE for receiving instruments, Daisy Pump Gun, shot, target, $2.50. Post Card Projector (gas), $3. Write Claude Ireland, 3436 W. 60th Pl., Chicago.

WILL SELL slightly used 3" Bunnell coil equipped with large contacts for $8.50. Eugene Hartnell, Salem, Wis.

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FOR SALE—Round double filament De Forest Audion Bulb, graphite potentiometer, Ferron detector, Rodiocite crystals, etc. All brand new and bargains. J. R. Dean, Rochester, N.Y.

FOR SALE—½ Kilowatt Packard, $13; 1 Kilowatt Rotary, $7; Marconi Type B Oscillation Transformer, $8; Arlington Receiving Transformer, $4; Ferron Detector, $2.50. All perfect condition. Write for list. Herman Werner, 41 Fay Street, Akron, Ohio.

WILL SELL OR TRADE my large Switchboard Voltmeter and Ammeter, each $8; Americanized Encyclopedia Britannica, $10; 3¼ by 4¼ camera, uses plates or films, very fine lens, $15; hot wire Ammeter, $2.75. Good Typewriter or gun needed. Wm. Leffler, Tiffin, Ohio.

FOR SALE OR EXCHANGE—Chamber's Loose Coupler, $3.50; Brandes Receiver, $1. Write for large list of wireless and experimental apparatus. All letters answered. Thomas Hannold, Paulsboro, New Jersey, R.F.D.

FOR SALE—Otis Clapp Statis Machine in first-class condition. Two 19" plates on hand operated end. Ten 29" plates on power operated end. Several Leyden jars and various discharging devices to go with machine. Cabinet measures 66"x66"x30" wide. All enclosed by glass, $75, f.o.b. Mattapan, Mass., Cost $450. Fritz Henrici, Mattapan, Mass.

FOR SALE—$35 violin, Stradivarius model, sweet, mellow tone, $28, or will exchange for wireless receiving set, of equal value. Write, Andrew Swanick, Fords, N.J. Box 394.

FOR SALE—Smith 1917 Motor Wheel. Want 1 K.W. Thordarson transmitting set or part. Also Duck's 5 A A Navy Type Coupler. Leonard Edick, 89 Forest, Gloversville, N.Y.

EXCHANGE—Steven's Pistol, 45/70/405 Rifle, Double barrel Shotgun, Scout camera and outfit, for High Tension Motorcycle Magneto 1 cylinder. Arthur Jenson, Carpenter, N. Dak.

FOR SALE—1200 meter Duck Loose Coupler, New, $3.50; 2 fine home-made loaders, 2000 and 1500 meters, $1.25 and $1; 1" Bulldog spark coil, $3.50; telegraph sets; helix; Knapp Reversing Switch, 50c. Write me. All letters answered. Thomas Cumming, Sound Beach, Conn.

HAVE—Induction motor, Tesla 1 inch coil, No. 3 Erector, etc. Want variables, audion bulb, storage crystaloi ,etc. Write, Kenneth Marshall, Dowagiac, Mich.

WANTED—Late model twin motorcycle (Indian preferred) in exchange for 1/6, ¼, ½ A. C. motors. All letters answered. Enclose stamp. Tom Otis, Cedar Rapids, Iowa.

FOR SALE—Complete wireless 48 ft.; Arlington Transformer; Variable Condenser; Fixed Receiving Condenser; Electro Potentiometer; 1" spark coil; Pair Wireless Receivers; 600 volts lightning switch; all in good condition. B. Hajnacki, 1428 W. Superior St., Chicago, Ill.

AUDIO-TRON panel; Powers six motion picture machine, no lens; E.E. Half K.W. open core transformer with interrupter; 400 exposure kodak with stereopticon-enlarger, cost about $60; Make offer, cash, trade. Two filament tubular detector bulbs, $3.48. Hicks, Marion, Ill.

TRANSFORMER COIL with vibrator, $5.50; edgewound strip, $1; condenser plates, 70c; 2500 M. coupler, $4.50; sounder, $1; "Electrical Experimenter" 1915-16, $1.50; Ansco V. P. camera, $2. Want cash or Type D. tuner. Ralph Kunau, Sabula, Iowa.

FOR SALE—Audio-Tron Detector, brand new bulb, $5.50; 155 ft. aerial 2 copper wires, 10½" Electrose insulators, $2.50. Write, Harry Griffith, 5727 Broadway Ave., Chicago, Ill.

FOR SALE—4 Volumes Cyclopedia of Applied Electricity, $5.75; Thordarson step down transformer to 26 volts, $3.75; Base ball glove, 95c. Kenneth Houser, 631 N. Topeka, Wichita, Kansas.

FOR SALE—Transformer Coil Vibrator, 2 electrolytic Interrupters, 6 wet batteries. Excellent condition. All for $16. Rupert Keupf, Genesee, Idaho.

STEWART PHONOGRAPH—Brand new, cost $6, with popular records, $4.30. Carl Barnickol, 425 Davidson, Indianapolis, Indiana.

WANT MOTORCYCLE—Have $200 worth electrical and wireless apparatus to exchange. Coyd Maffet, Opal, Colo.

SALE OR TRADE—New 12 volt 10 ampere generator. Want Phones, Audion, Transformer, or what? G. Henningsen, W. 4th St., Fremont, Neb.

Opportunity Exchange

YOU will probably find more opportunities and real bargains in these columns than anywhere else in the country. Most good things in life are hard to find and worth going after—these little ads illustrate that point; you alone will be the real loser if you don't take the time to scan through these columns.

Advertisements in this section 4c. a word for each insertion. Count 7 words per line.

Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

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Advertisements for the May issue should reach us not later than March 25.

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FREE HANDBOOK for mechanics and contractors in any line. Shows how to make your work easy; do more and better work and save money. State your occupation and the book is yours FREE. Van Expansion Bolt Company, 26 F West Lake St., Chicago.

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BIG INCOME Writing Advertising. Complete Course 18 lessons, only $1. Worth $10. Educational Bureau, New Egypt, N.J.

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THOUSAND MEN AND WOMEN, 18 or over, WANTED everywhere, for U S. Government Life Jobs. $75 month, Steady Work. Short hours. Rapid advancement. Common education sufficient. Write immediately for free list of positions now easily obtainable. Franklin Institute, Dep't A 27, Rochester, N.Y.

MISCELLANEOUS

ELECTRICIANS—Send 50c. for 10 Blue Prints of Motor and Generator Connections. 28 for $1, 10 A.C., 4 D.C. Motor Winding Diagrams for $1 or 20 A.C., 4 D.C. and 4 Rotary Converter Drawings, $1.60. Winding made easy. Martin Electric Co., 329 Irvington Pl., Denver, Colo.

CARTOONISTS WANTED—DON'T BE A JACK-OF-ALL-TRADES—MASTER ONE. Cartoonists earn from $25 to $200 per week. Talent or special education unnecessary. This School guarantees to make you successful. Send postal for test lesson and particulars. Dept 501, THE DENNON SCHOOL FOR CARTOONING, Harrison, N.Y.

EVERYBODY WANTS IT—Folding pocket Coat and Hat Holder. Can attach anywhere and remove instantly, nickel-plated. Sample 10c. Big seller for agents. Wedge Mfg. Co., "Km" Binghamton, N.Y.

STAMPS—75, all different, free. Postage 2c. Mention paper. Quaker Stamp Co., Toledo, Ohio

AGENTS—500 per cent profit putting initials on automobiles. Particulars sent free. Address, Auto Monogram Co., 2025 E. Monmouth St., Philadelphia, Pa.

LUBRICANT CARBON REMOVER—Works without Attention; efficiently; smoothly; harmless. Fully guaranteed. Price per can, $1. Buy from C. Schuetz, 1875 N. Leavitt St., Chicago, Ill.

BARGAIN—Five electric stoves, twenty feet of wire and plug, each $1 prepaid, never used. Richard Gaillard, Pendleton St., Columbia, S.C.

AMATEUR PHOTOGRAPHERS—Send for our catalog on photo supplies. We retail to you at wholesale prices. Films developed, 8c. Cortland Merchandise Co., Dept. E, 1851 N. Kildare Ave., Chicago, Ill.

KODAK FINISHING—First roll developed and printed, twenty cents. O. Ramsaur, West Raleigh, N.C.

PHONOGRAPHS

BUILD YOUR OWN PHONOGRAPH or manufacture them for profit. Drawings, instructions, etc., Twenty-five Cents. Satisfaction guaranteed. Circular free. Associated Phonograph Co., Dept. E, Cincinnati.

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AMERICAN AND FOREIGN PATENTS obtained. Before selecting an attorney, write for our solid instructive advice; join the ranks of happy inventors. Correspondence Office, 125 East Twenty-third St., New York City. F. V. Winters, Reg. Patent Lawyer, New York City, and Washington, D.C.

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JOHN M. McLACHLEN, attorney-at-law—Patent causes. Union Trust Bldg., Washington, D.C.

ENGINES

¼ H.P. 2-CYCLE ENGINE, $21; ½ H.P., $26; ½ H.P. 4-cycle, $28. Electric light plant, to run twenty 12-c.p. lamps, $61. Dynamic Manufacturing Co., First National Bank Bldg., Chicago.

WIRELESS

TELEGRAPH—Morse and Wireless—also Station Agency taught. Graduates assisted. Cheap expense—easily learned. Largest school—established 42 years. Correspondence courses also. Catalog Free. Dodge's Institute, Lone St., Valparaiso, Ind.

GALENITE—Sensitive detector mineral. Send 10c. for liberal sample. Fully tested. M. P. Gilliland, 753 Brazee St., Portland, Ore.

Amateurs and Experimenters!! DO U NO THAT U ARE LOSING MONEY UNLESS YOU HAVE OUR CIRCULARS??? Send for our circulars No. 100 and No. 101, they list all standard apparatus at astonishingly LOW PRICES, and a complete line of parts some of which the amateur has never before been able to secure at any price. U NEED THESE CIRCULARS!! THEY WILL SAVE YOU DOLLARS!!! BARGAINS:—A few double filament supersensitive Audion bulbs, absolutely and positively guaranteed or money refunded, each $3.45 or 3 for $9.85. We have two new types of REGENERATIVE SETS for short waves, send for these circulars. Parts lathe turned for your variometer, $2.45. We make cabinets of all kinds, with FORMICA panels, high grade workmanship guaranteed, lathe work is our specialty. LET US QUOTE YOU on ANY PART OR INSTRUMENT THAT YOU HAVE IN MIND. 35c. brings you a MOULDED GRID CONDENSER for YOUR AUDION!!! $25 brings you a $30 1 K.W. Thordarson Transformer!!! Write to us now before you forget it. Mid-West Wireless Mfg. & Supply Co., Mattoon, Ill.

NAVY TYPE COUPLER, wound with silk covered wire, hard rubber panel. Special price $5. After March twenty-fifth, $6.50 Large coupler wound with silk covered wire, Mahogany Finished woodwork, Special $5. Audio-tone, the new guaranteed wireless detector, $1.25. Send 3c. for circular. K & P Apparatus Co., 1062 Franklin Ave., Bronx, N.Y.

FINE WOOD variometer parts. Secondary ball 4-inch diameter, primary pieces to fit. Form for winding primary furnished. Only $3 prepaid. John von Ardyn, 125 Riverside Drive, New York City.

RECEIVING SET, complete with 2000 ohm Murdock Phones, $7.50. Best $1 cat whisker detector. Photo and description for stamp. Catalogs six cents. Anything from a buzzer to a 1 K.W. set. Lester Jenkins, 74 Smith St., New Bedford, Mass.

CRYPTON—Latest detector mineral Ultra-Sensitive—15c. generous piece. Crypton Sales Co, Box 358, Dalton, Mass.

APRIL SPECIAL—Audion bulb FREE with every order for the ultra-sensitive "PARAGON" Amplifying Short-Wave Receiver at $35. You're out of the game without one of these wonderful sets. Order TO-DAY. New catalog of QUALITY apparatus at money-saving prices for stamp. Arthur B. Church, Lamoni, Iowa.

WOOD PARTS for 4000 M. Coupler finished in beautiful polished mahogany, size 18x7x7½ in. While they last, with blue prints, 98c. Include postage for three pounds. Louis E. Schwab, 3708 Brooklyn Ave., Cleveland, Ohio.

DETECTO-AMPLIFIER tubes, $6.50 cash. Guaranteed by the manufacturers. Paul D. Flehr, Ironton, Ohio.

SEND self-addressed postal for my reduced price on any wireless instrument made. Edwin L. Powell, 216 Spruce, Takoma Park, Md.

FOR SALE—Goods brand new. 2 Murdock head sets, 2000 ohms each, $3 each; 3 Murdock, 43 plate variable condensers, $3 each; 1 dozen 12 ampere hour storage cells, $1.25 each; 4 10 ohm rheostats, 40c. each; 1 $10 omnigraph with dials (slightly used), $6. Also have fifty dollars' worth of raw materials, parts for instruments, tools, etc., such as silk covered wire, contacts, taps, Bakelite, etc., for sale cheap. Write for big list and prices. All inquiries answered. Harold McCullough, 262 Main St., Petaluma, Cal.

ALL OR PART of forty pounds single cotton covered magnet wire No. 26. Second hand. Good condition. Also a few sets almost new books by famous authors. Details on request. C. M. Maxon, Walworth, Wis.

WHAT'S YOUR RANGE? I listen for you; send you weekly reports; 50c. monthly, 1, 2, 3, 4, and 8 stations please write. G. Kenneth Thompson, Maplewood, N.J.

GET BETTER RESULTS by using a sterling silver detector spring, 25c. prepaid. Guaranteed to be sterling silver. Address, Malcolm Burton, 1157 Third Ave., Salt Lake City, Utah.

2000 OHM COMPLETE DOUBLE SET $4.00

MURDOCK No. 55

3000 OHM COMPLETE DOUBLE SET $5.00

Price

No other radio receivers in the world, equal in quality of materials, workmanship, appearance, comfort, and operating efficiency, are available at such remarkably low prices.

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Whether for long or short distances, these exceptional receivers PERFORM with a sensitiveness and a reliability which is a matter of surprise to those who have paid twice as much for other sets.

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It is a simple matter to talk price *alone*. You may buy *some* things on that basis. BUT—when you are about to buy a set of radio receivers, price alone should not determine the choice.

So, in offering these exceptional phones at very low prices, we add a word about PERFORMANCE, for we believe that in actual use no overwhelming superiority can be attributed to ANY more costly instruments.

Our proposition is simple—Buy a set of these phones. If, after

Fourteen Days' Trial

you are dissatisfied with them in ANY way, send 'em back and get your money.

Thousands of operators everywhere have believed what we say—and thousands of sets NOW IN USE prove by their performance our claim that we are delivering the *best radio receiver value in the world.*

Your Order For a Set Now Will Insure Immediate Delivery

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Your Choice For Ten Days' Wear Free

HERE is the most amazingly liberal offer ever made on wonderful gems. To quickly introduce into every locality our beautiful TIFNITE GEMS—which in appearance and by every test are so much like a diamond that even an expert can hardly tell the difference—we will absolutely and positively send them out FREE and on trial for 10 days' wear. But only 10,000 will be shipped on this plan. To take advantage of it, you must act quickly.

Send the coupon NOW! Send no money. Tell us which item you prefer—Ring, Pin or LaValliere. We'll send your selection at once. After you see the beautiful, dazzling gem and the handsome solid gold mounting—after you have carefully made an examination and decided that you like it—if you believe you have a wonderful bargain and want to keep it, you may pay for same in small easy payments as described in this advertisement. If, however, you can tell a TIFNITE GEM from a genuine diamond, or for any reason you do not wish it, return at our expense.

TIFNITE GEMS—Solid Gold Mountings

are recognized as the closest thing to a diamond ever discovered. In fact, it requires an expert to distinguish between them. In appearance, a Tifnite and a diamond are as alike as two peas. TIFNITE GEMS have the wonderful pure white color of diamonds of the first water, the dazzling fire, brilliancy, cut and polish. They stand every diamond test—fire, acid and diamond file. The mountings are exclusively fashioned in latest designs—and guaranteed solid gold.

FREE TRIAL COUPON

THE TIFNITE GEM CO.

Rand-McNally Bldg., Dept. 97, Chicago, Ill.

Send me..... No..... on 10 days' approval. (In ordering ring be sure to enclose size as described above) If satisfactory, I agree to pay $3.00 upon arrival, and balance at rate of $3.00 per month. If not satisfactory, I will return same within ten days.

Name.....

Address.....

Send No Money—Send No References

Just send coupon. You do not obligate yourself in any way. The coupon—only the coupon—brings you any of the exquisitely beautiful pieces shown and described here. If you want ring, state whether ladies' or gentlemen's, be sure to enclose strip of paper showing exact finger measurement as explained below

Send coupon now and get a TIFNITE GEM on this liberal offer. Wear it for 10 days on trial. All set in latest style solid gold mountings. Then decide whether you want to keep it or not. Send for yours now—today—sure.

In Ordering Rings To get the right size Ring, cut a strip of heavy paper so that the ends exactly meet when drawn tightly around the second joint of finger on which you want to wear the ring. Be careful that the measuring paper fits snugly without overlapping, and measure at the second joint. Send the strip of paper to us with order coupon.

The Tifnite Gem Company Rand-McNally Building Dept. 97 Chicago, Ill.

Flat Belcher Ring

No. 1. Solid gold mounting. Eight claw design with flat wide band. Almost a carat, guaranteed genuine Tifnite Gem. Price $12.75; only $3.00 upon arrival. Balance $3 per month. Can be returned at our expense within 10 days.

Ladies' Ring

No. 2. Solid gold Tiffany mounting. Has a guaranteed genuine Tifnite Gem almost a carat in size. Price $12.25; only $3.00 upon arrival. Balance $3 per month. Can be returned at our expense within 10 days.

Tooth Belcher Ring

No. 3. Solid gold, six-prong tooth mounting. Guaranteed genuine Tifnite Gem almost a carat in size. Price $12.25; only $3.00 upon arrival. Balance $3.00 per month. Can be returned at our expense within 10 days.

Ladies' LaValliere

No. 4. Solid gold throughout. Chain 15 inches long. One-half carat guaranteed genuine Tifnite Gem artistically mounted in genuine latest style Black enamel circle. Price $14.25; only $3.00 upon arrival. Balance $3.00 per month. Can be returned at our expense within 10 days.

Scarf Pin

No. 5. Solid gold throughout. A beautiful open circle mounting. Half-carat guaranteed Tifnite Gem. Price $12.25; only $3.00 upon arrival. Balance $3.00 per month. Can be returned at our expense in 10 days.